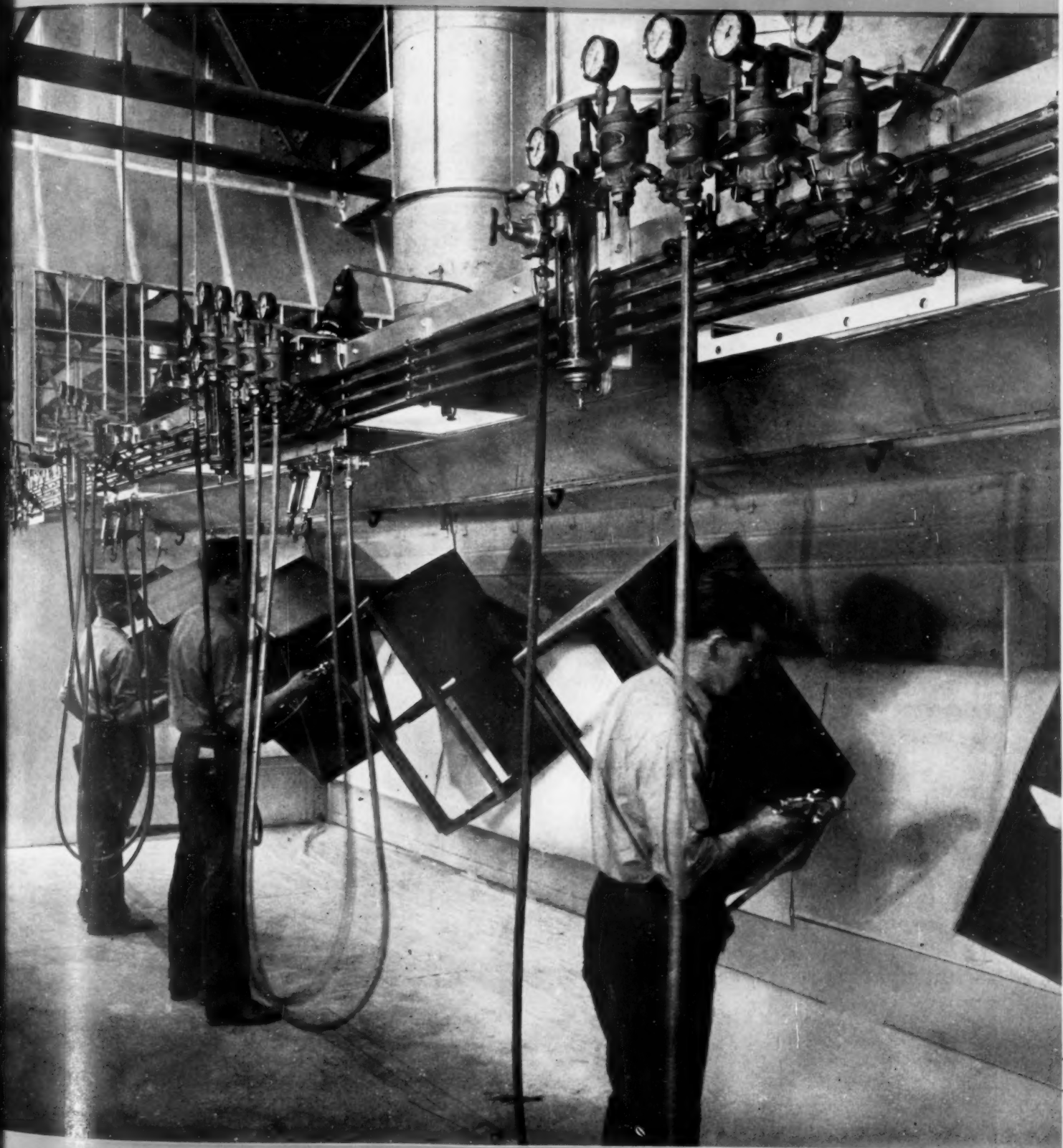


OCTOBER, 1940

ORGANIC FINISHING

SECTION OF METAL FINISHING



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INFRA-RED BAKING.. Progress and Problems

For several years Zapon has carried on experimental work in its laboratories with infra-red lamps. A close study was made, too, of the original development of this method of baking finishes in the automobile industry.

It is important to remember that enthusiasm for infra-red's quick baking schedules must not cause us to overlook many other factors. We have found that some finishes which bake out satisfactorily in conventional ovens are not suitable for infra-red

baking. Color of the finish to be applied, type of surface and shape of the object, production schedule and other considerations influence the results obtained. No single material or method of set-up will work in all cases.

Users of industrial finishes interested in the infra-red process should work closely with the finish manufacturer as well as the maker of equipment. Zapon is fully competent to work with you on such a program.

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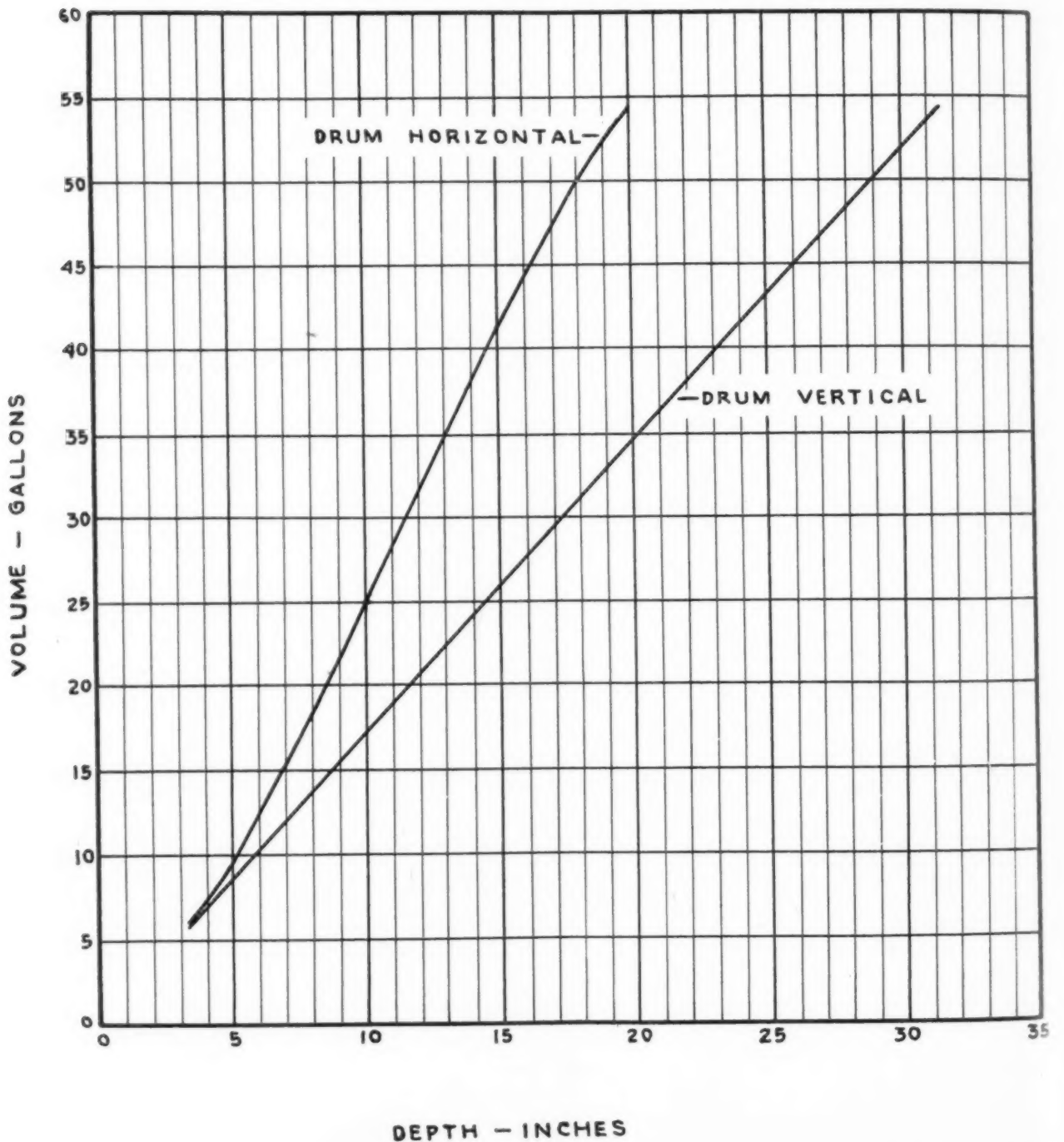
Much credit is due to the industrial finishers of twenty-five and more years ago. The quality of work produced by them is a monument—nothing less—to their ingenuity, their patience and their common sense. Consider the materials and the equipment with which they had to do. The former were limited in number and not particularly dependable. The latter were certainly not models of efficiency, to say the least. It is no wonder that samples of their work which still exist can create comments of praise.

With our new variety of finishing materials and our highly efficient finishing equipment some of us have become, perhaps, just a little smug in our attitude toward the finishers of a few years back and the manner in which they obtained their results. Occasionally one even hears the phrase, "old time finisher", said with considerable condescension. That attitude is entirely wrong. We must remember that finishing today is largely the result of the hard work of those old time finishers. They were the ones who did all the difficult ground work, experimented, tried everything and failing tried again. They were the ones who knew the limitations of their tools and pointed the way to faster and better finishing. We owe them much for creating the foundation on which modern finishing is built.

DRUM VOLUME CHART

The following drum volume chart will be found useful for quickly and easily determining the approximate contents of 55 gallon (34 $\frac{7}{8}$ " x 24") drums containing finishing materials, thinners, etc.

Any suitable measuring stick marked in inches, such as an ordinary yardstick, may be used. The measuring stick is inserted into the drum through the top opening (if the drum is in the vertical position) or through the side opening (if the drum is horizontal) with the one inch graduation down. Care must be taken that the stick is straight, that it is held vertically and that it touches the bottom of the drum before being withdrawn. On withdrawal, the depth in inches on the stick is noted and reference to the chart will show the approximate number of gallons of liquid in the drum.



Putting the Heat on White Enamels *

By John McE. Sanderson

*American Cyanamid & Chemical Corp.
New York City*

ALL during my school years I slept in an iron bed, the original finish of which was white enamel but which had become so chipped and battered as to be hideous to behold. Perhaps because of this I unconsciously acquired an ambition to make better white enamel. Or maybe it is just a coincidence that after all these intervening years I find myself working for a concern that can claim some share in doing just that.

When I left home (and that battered iron bed), it was to take my first job in the paint industry, and here I learned why that bedstead chipped so easily. For at that time to make a white enamel which would be hard and glossy and still remain reasonably white, we used as a vehicle cold cut damar gum with little or no oil and pigmented with zinc oxide and lithopone so that several coats were needed for opacity. The upper limit of baking temperature to avoid discoloration was about 150° F. and it was customary to bake for several hours or even to leave articles in the oven overnight, thus requiring tremendous oven capacity in relation to a limited output.

For tints and cheap whites we used cooked varnishes, and some of those made from wood oil, soybean oil and ester gum were not so bad. Still, they had to be baked at relatively low temperatures for several hours and were far from resistant to yellowing either on over-baking or on aging of the finished article.

Alkyd Resins

The first real improvement over the old-fashioned varnish vehicle came with the development of the oxidizing type alkyd resins a dozen or so years ago. By that time we also had available titanium oxide, the high opacity

This article describes advantages and disadvantages of the urea, alkyd and the new melamine resins now sold under the trade name of "Melamac" resins. The properties of mixed resin enamels are also described.—Ed.

of which not only offset some yellowing of the vehicle but also cut down the thickness of film required for satisfactory covering. Some of the early alkyd resin finishes showed a disappointing tendency toward yellowing on aging, although they were better than oleoresinous varnishes in this respect.

However, in recent years new alkyd resins have been developed which are distinguished by remarkably improved color retention and which are available in a wide range of flexibility and solubility characteristics. With enamels made from these new materials, the manufacturer of refrigerators and other appliances has been enabled to raise temperatures to 275° F., cut his baking time to around 1½ hours, and come out with a finish having excellent adhesion and resistance to humidity, grease, impact, and abrasion.

Coincident with the development of the oil modified alkyd resins, there were also developed the rosin modified maleic grades for use in oleoresinous varnishes. For a good combination of drying speed, water resistance, and color retention, these resins have generally been cooked with a mixture of wood oil and heat bodied soybean oil. More recently they have been found especially advantageous for use with dehydrated castor oil. Such varnishes, while not equaling the best of the straight alkyd types in color retention, adhesion and toughness, are distinctly superior as white baking enamel vehicles to varnishes made from previously available resins. They are ordinar-

ily baked at 225° F. or lower temperatures, with metallic drier kept at a minimum to avoid discoloration.

Urea Resins

A further revolutionary advance in the art of making white baking enamels was contributed by the development of the organic soluble urea resins, such as the well-known Beetle types. The judicious addition of these to alkyd resin vehicles steps up resistance to heat so that white enamels made from them can be baked at temperatures up to 325° F. without appreciable discoloration. At the same time baking schedules can be cut in half and in many instances down to a few minutes.

In the production-line finishing of cabinets and similar articles, it is customary to fasten on the handles and other fixtures right after the finished pieces emerge from the oven. While they are still hot, enamels made from alkyd or varnish vehicles are relatively soft and in consequence easily damaged. On the contrary, enamels made from urea resins are so hard, even while the finished article is still hot, so as not to be readily damaged, thus reducing touch-up costs to the vanishing point. Urea-alkyd resin combinations produce a baked finish which is resistant to scratching and abrasion, pleasing in gloss and appearance, and free from discoloration, not only in baking but on subsequent exposure of the finish.

Melamine Resins

Considering the degree of improvement imparted by urea-alkyd resin combinations compared with the vehicles available a dozen or more years

*Reprinted from "Paint, Oil & Chemical Review," Issue of June 6, 1940

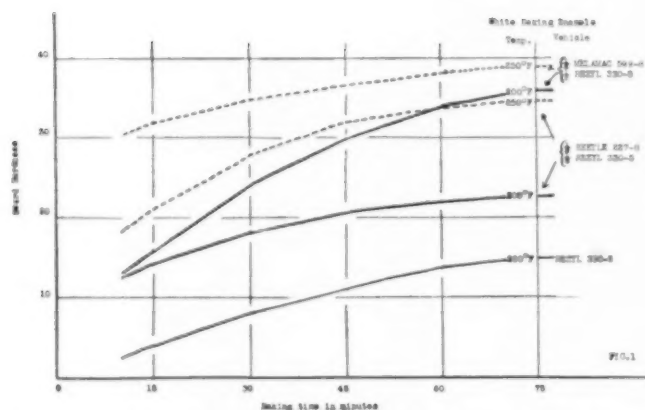


Figure 1. Curves illustrating relative hardening effect of urea and melamine resins on alkyd resin enamel.

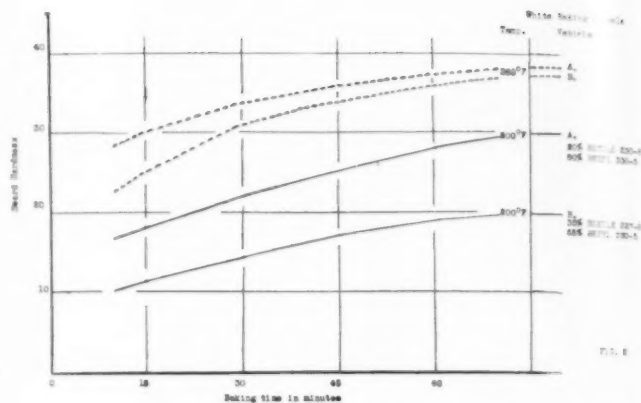


Figure 2. Curves showing the relative hardening effect on an alkyd enamel of 20 per cent melamine resin versus 35 per cent urea resin.

ago, it might seem that we had reached the ultimate in white baking enamels. On the contrary, they have inspired dissatisfaction and pointed to the need, or at least the possibility, of still further improvement. And this is just being realized with resins made from melamine which are now commercially available under the trade name "Melamac". These, like the urea resins, are thermo-setting types, supplied as solutions in organic solvents and generally used for baking enamels in combination with alkyd resins. They have certain outstanding characteristics of definite interest to the enamel manufacturer, which account for their rapidly expanding application.

In the use of alkyd-melamine resin enamels, one thing immediately noted is that they may be baked at relatively low temperatures while still obtaining the speed and hardness formerly secured only with high bakes. It is, of course, well known that, with the use of strong catalysts, it is possible to lower the cure of urea resins even down to the point where they can be hardened at room temperatures.

Nevertheless, with urea resin vehi-

cles meeting the usual requirements for white enamels, it is still desirable to bake in the range of 250° to 325° F. Similar enamels based on melamac resin may, on the other hand, be baked satisfactorily at temperatures of 180° to 225° F, and yield films of excellent hardness and gloss as well as exceptionally resistant to humidity, chemicals and heat.

The curves in Figure 1 show the hardening effect, in white enamels, on an oxidizing type alkyd resin by mixing it in one case with an equal quantity of urea resin and in another with an equal quantity of melamine resin (already partially plasticized with alkyd). It will be noted that the melamine combination bakes quite hard in 45 minutes at 200° F., while both the straight alkyd and the urea-alkyd mixture remain relatively soft even after 1¼ hours at 200° F. In an hour's bake at 250° F. the urea resin enamel reaches the same hardness as the melamine resin enamel attains in the same time at 200° F. On the other hand, if the melamine resin enamel is baked at 250° F., it reaches in 30 minutes the same hardness for which the urea resin

enamel requires over an hour at this same temperature. This sharp reduction in time permits a corresponding increase of production in commercial finishing.

Still another way to take advantage of the speed and hardness of the melamine resins is to use them with larger proportions of alkyd resin than would be used with urea resin with consequent economies in formulation. In the curves shown in Figure 2 it will be noted that in an hour's bake at 250° F. the hardness of an enamel containing 35 per cent urea resin is substantially the same as that attained with only 20 per cent of a melamine-urea combination mixed with the same oxidizing type alkyd. In bakes at 200° F. with the same enamels the melamine resin mixture shows up to marked advantage.

I have already mentioned the improvement in heat resistance effected by the addition of urea resin to alkyd types. Such combinations in white enamels yield excellent results when baked at temperatures up to 325° F., but rapidly lose both gloss and color when subjected to appreciably higher

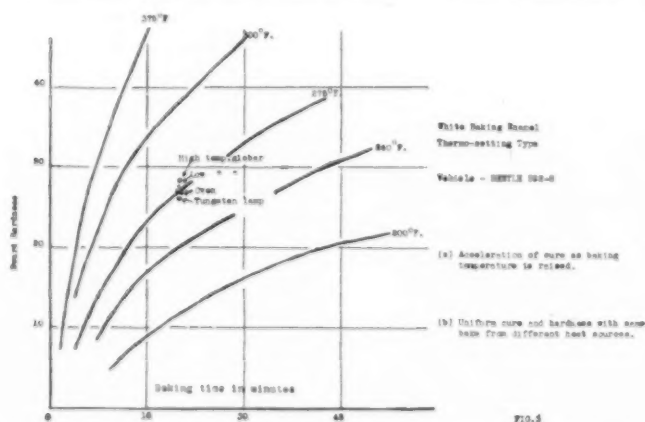


Figure 3. Curves showing influence of time and temperature of bake on hardness of film of a thermo-setting urea-alkyd enamel.

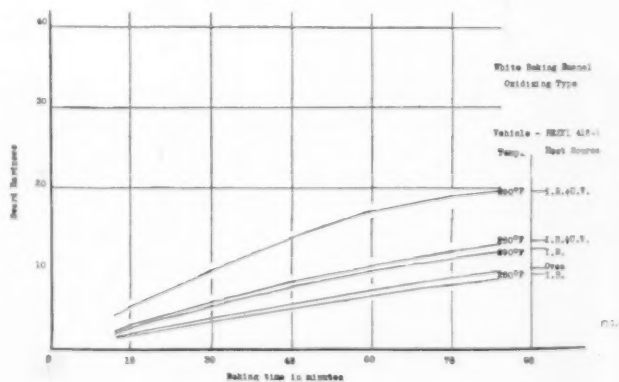


Figure 4. Curves showing accelerating influence of ultra-violet light on baking of an oxidizing type alkyd resin enamel.

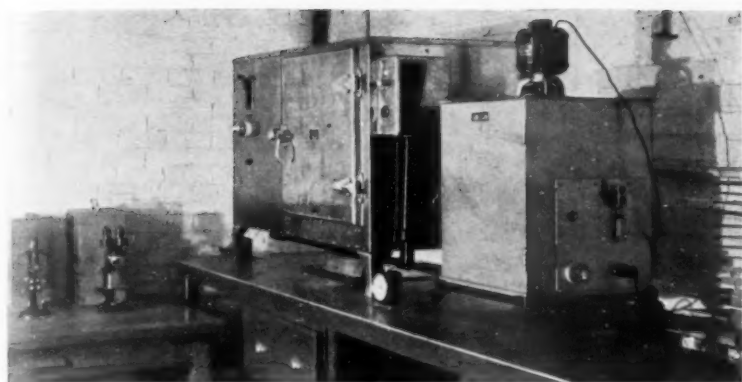


Figure 5. Electrically heated ovens equipped with forced ventilation for laboratory tests on baking enamels.

temperatures. Some of the Melamac resins, on the other hand, when used in conjunction with the highly heat resistant Rezyl resins which have been developed especially for such use, retain both gloss and color on prolonged subjection to temperatures as high as 425° F. This in turn means the use of such enamels, usually over an alkyd primer, on stove parts, electrical appliances, etc., for which vitreous enamel or metal plating have formerly been considered necessary.

White baking enamels made from these new resins are more resistant than comparable types based on urea resins not only to elevated temperatures but also to chalking on outdoor exposure. Furthermore, they are less readily affected by high humidity or contact with grease, acid, alkali, or solvents.

Baking Ovens

The development of the various synthetic resins described above and the improvement in speed and quality through their use have stimulated the application of baking enamels in a wide variety of industries. Along with this has come improvement in equipment used for baking through study

of oven design, heat sources, and the factors which influence the hardening of various types of films.

For older types of white enamels based on varnish vehicles and baked at temperatures of 150° to 200° F., ovens heated by steam coils were almost universally employed. For this purpose they were safe, efficient, and simple to operate and control. Many owners of such ovens, reluctant to discard them and invest substantial capital in new baking equipment, have continued with the use of finishes which are no longer first-class by today's standards of quality. The adoption of enamels based on Melamac resins will remedy this situation since they can be baked in steam heated ovens to hard and highly resistant finishes.

With the advent of alkyd resin enamels, and especially to get the speed, hardness, and humidity resistance demanded for refrigerator finishing, baking temperatures were raised to a range of 250° to 275° F. Urea resin enamels could be baked in the same range as the alkyd types, but to take full advantage of their possibilities, it became desirable to go up around 300° to 325° F. Melamine resins, as noted above, permit when desired a return



Figure 7. Modern white baking enamels are used on a wide variety of household and industrial appliances.

to low bakes in steam heated ovens. On the other hand with them, for maximum speed of output ovens can be operated at even higher temperatures than with urea types.

For baking temperatures beyond those obtainable with low pressure steam, other sources of heat must be utilized. In ovens heated by open flames, there is an ever-present fire and explosion hazard due to the presence of highly inflammable solvent vapors. Furthermore, many baking enamels which are entirely satisfactory in normal atmospheres tend to flatten and wrinkle when subjected to gas fumes. Another point of difficulty is that of maintaining uniform conditions throughout the oven. It is obvious that pieces nearest the burners will receive excess heat both from convection air currents and by direct radiation.

Indirect heat from enclosed gas or oil burners or the use of electric resistance heaters, together with adequate ventilation, will eliminate the difficulties due to foul oven atmospheres. Such heating methods also lend themselves readily to the exact control of uniform temperature throughout the oven which is so necessary for good results. With the older types of white enamels any portions of the work that were over-baked were easily spotted, since only a few degrees over the normal baking temperature were sufficient to produce notable yellowing. This is not the case with modern enamels, particularly those based on Melamac resins which show practically no difference in color between 200° and 400° F. Nevertheless, if an enamel is designed to bake 30

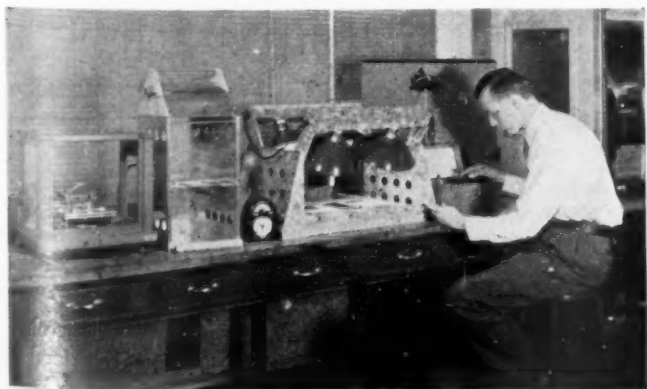


Figure 6. Experimental equipment for testing baking with various heat sources including oven, infrared lamps, and globar. At left is Sward rocker for checking results.

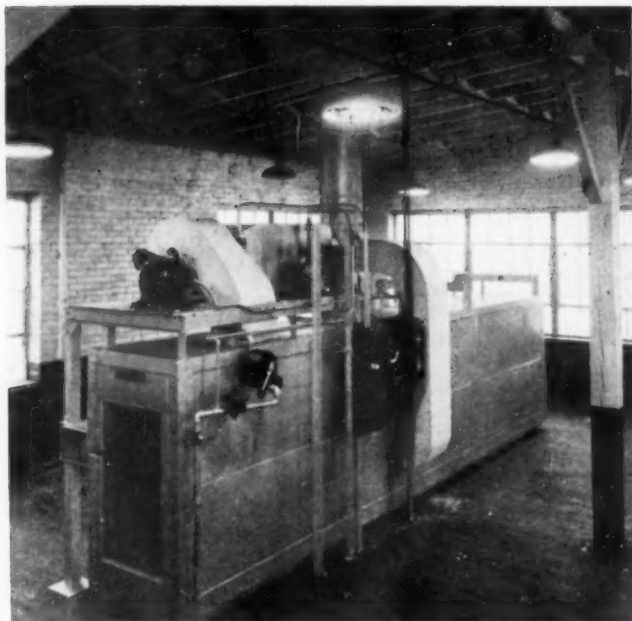
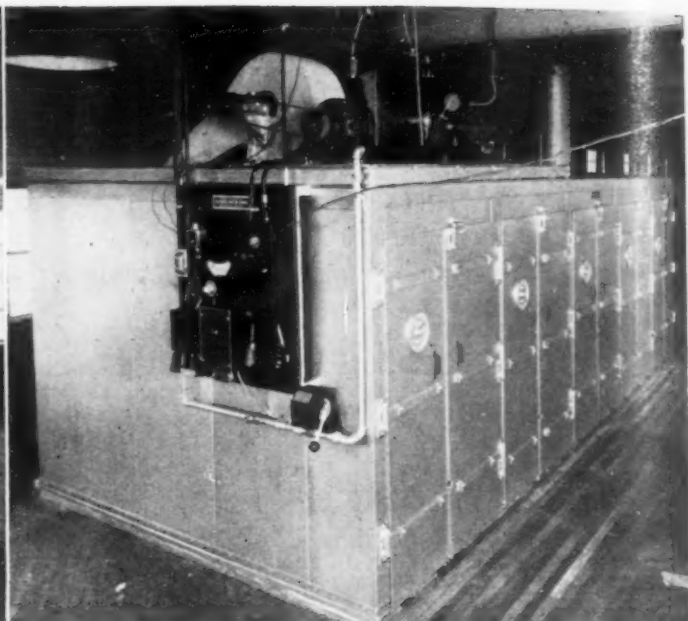


Figure 8. Continuous baking oven prior to installation of conveyor.



Courtesy George Koch Sons, Inc.
Figure 9. Commercial cabinet type baking oven showing ventilation and control equipment.

minutes at 300° F. it may be too soft if it only gets 200° F., or too hard and brittle if it goes to 400° F. for the same time.

Infrared Baking

The ordinary types of baking ovens, whether heated by steam, gas, or electricity, depend mostly on convection air currents for the transfer of heat. They must heat not only the enamel on the surface but also practically the entire article to be finished. This sometimes means heating a considerable mass of metal with consequent lag in getting the finish up to the desired baking temperature. A method of baking, to which Ford Motor Co. has made important contributions, and which gets around this difficulty to some extent, is the use of infrared radiation from electric lamps. These are usually carbon filament types with the reflectors gold plated to avoid tarnishing and thus maintain maximum efficiency through long periods of use. Infrared radiation travels in a straight line and is highly effective where it can be focused on the surface of the finished article which is to be baked.

It is, of course, common knowledge that with equal film thickness and other conditions of application, the time required to harden an enamel decreases rapidly as the baking temperature is raised. However, the curves shown in Figure 3 will serve as a visual demonstration and reminder of this im-

portant fact. This represents a test on a white enamel, the vehicle for which consisted of equal parts urea resin and non-drying alkyd type. The hardness measured by the Sward rocker serves as a convenient check on the progress of the bake. It will be noted, for instance, that with 45 minutes at a temperature of 240° F. the enamel had reached the same hardness which was achieved in less than twelve minutes when the temperature was 300° F.

Determining Relative Effect of Heat

To determine the relative effect of heat from various sources, an experiment was conducted on this same alkyd-urea white enamel. Small steel panels were sprayed at uniform film thickness and baked on the same schedule (20 minutes at 275° F.) by different means. Temperatures were accurately measured by delicate thermocouples fixed to the finished surface of each panel. Besides an ordinary oven the heat sources included radiation from different portions of the spectrum provided by a high temperature globar, a globar at barely visible red heat, and a tungsten filament lamp.

As shown in Figure 3, resultant hardness of the enamel films ranged from 26 to 28, which is within experimental error of duplicate determinations, thus demonstrating that on a thermo-setting non-oxidizing enamel of this sort the wave length of the radia-

tion used to maintain a particular temperature for a definite time seems to make little or no difference in the final result. It should, of course, still be borne in mind that there may be a considerable lag in reaching the desired temperature in an oven as compared with radiant heat focused on the surface.

When we come to oxidizing type alkyd or varnish enamels, we get a somewhat different story. Here the introduction of light rays, especially ultra-violet, in addition to heat will accelerate the hardening of the finish. This is demonstrated by the tests on a white enamel based on an oxidizing type alkyd as shown in Figure 4. In the hardness curves of bakes at 250° F. and at 290° F. it will be noted that there is practically no difference between the oven and the infrared lamp, but that there is a notable increase in hardness when ultra-violet is combined with infrared radiation. This combination at 250° F. baked the enamel to a trifle better hardness than was attained with infrared alone at 290° F.

Undoubtedly in the future we shall see further improvements in vehicles for white baking enamels. In the meantime the synthetic resins now available, alkyd, urea, and melamine types, afford the enamel manufacturer ample opportunities to formulate a wide variety of finishes where the characteristics of each may be utilized to maximum advantage.

Surface Treatment of Steel Prior to Painting

PART II

By Rolla E. Pollard and Wilbur C. Porter

Superior results were also obtained with the hot-dip phosphate treatment on a scale-free and rust-free surface (panel *Fe-H-5a*). All panels in figure 6 were covered with an aluminum top coat over primer 5a. These panels were not scratched.

2. Accelerated-Weathering Tests

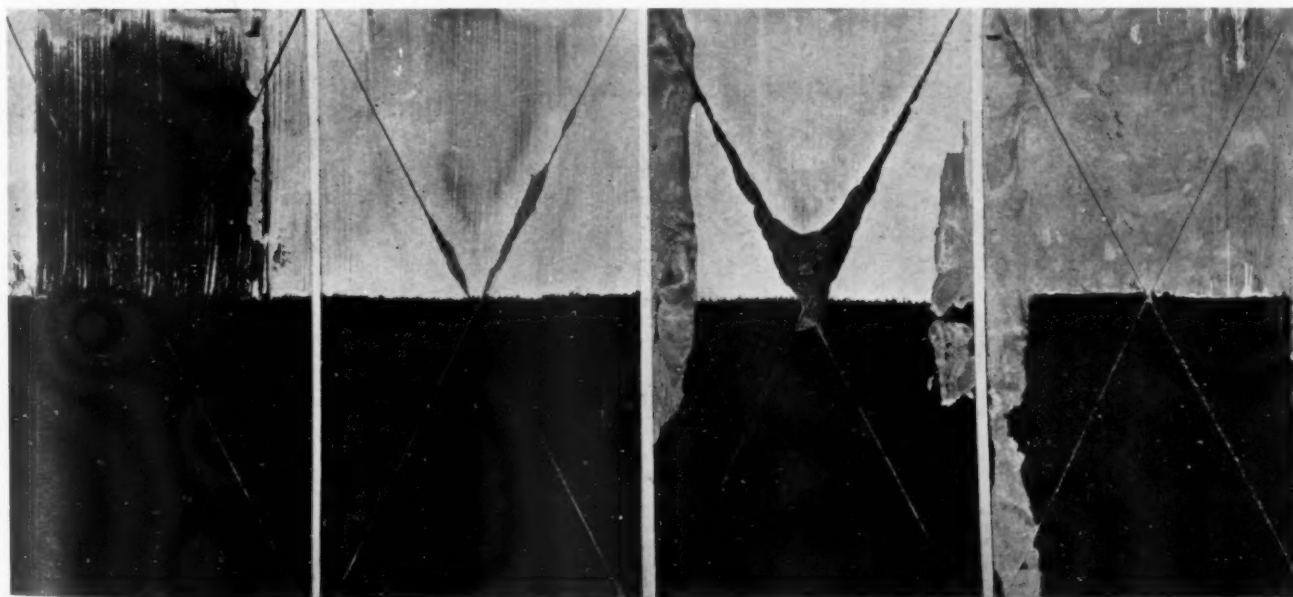
In the accelerated-weathering test, painted panels are exposed, alternately wet and dry, to the heat and light of a carbon arc lamp. During a 20-minute cycle the panels are exposed to the light for more than 18 minutes and are heated to about 54° C. They are then suddenly wet by a water spray at 15° to 21° C and are quickly dried off when they come under the light again to complete the cycle. Important factors affecting the breakdown of paint in this test are the action of light and the sudden change in tem-

This is the second part of the article which first appeared in the Sept. issue. In this installment results of accelerated weathering tests and condensation corrosion tests are given.

perature. It is believed that actual corrosion of metal due to moisture under the paint film is relatively unimportant.

The paints which stand up best under the accelerated-weathering test are those which have good adhesion and are opaque to light. Good adhesion is particularly important when primers and covering coats with different coefficients of expansion or different drying characteristics are used. A good test for adhesion of a primer is to use a hard-drying top coat, which, by drying at a rate different from that of the primer, tends to loosen the priming coat from the metal.

Opacity to light is, of course, a property of the paint itself. Adherence of the paint film, however, is markedly affected by the condition of the metal surface. Among the surface treatments listed for galvanized-steel panels, the hot-dip phosphate treatments *H* and *J* stood up best in accelerated-weathering tests, as shown in figure 7 (panel *H-5*). It will be noted that after 12 months' exposure most of the hard-drying top coat on the top half of the panel had chalked off, but the priming coat remained intact over the entire surface. In contrast, the same primer on the untreated panel *A-5* (fig. 7) was pulled off entirely by the top coat after 6 months and was also peeled on the bottom half in large areas at the edges subjected to abrasion by the vertical slots in which the panel rested during testing. The cold-wash phosphate treatment *B*



Panel H-5

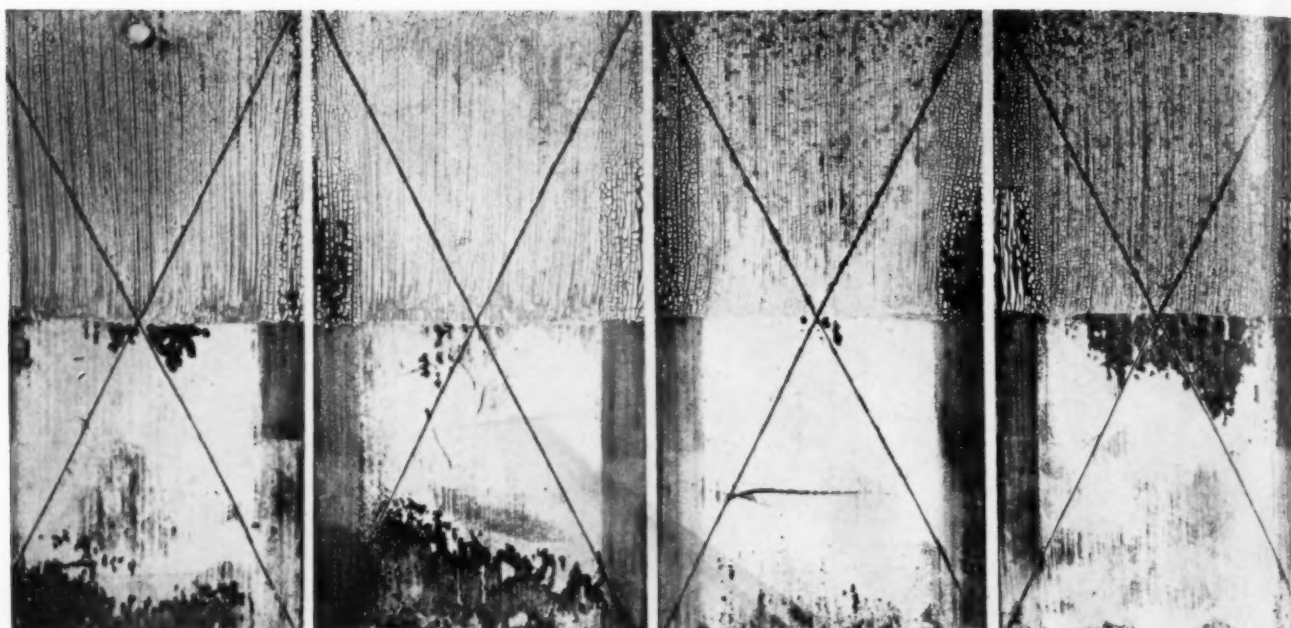
Panel B-5

Panel D-5

Panel A-5

Figure 7.—Comparison of accelerated-weathering tests of hot-dip galvanized-steel panels subjected to treatments H, B, D, and A prior to painting with two coats of primer 5.

The top half of each panel is covered with one hard-drying outside white top coat.
Panel H-5: Hot-dip phosphate treatment (H); accelerated weathering, 12 months' exposure.
Panel B-5: Cold-wash phosphate treatment (B); accelerated weathering, 6 months' exposure.
Panel D-5: Zinc-sulfate solution treatment (D); accelerated weathering, 6 months' exposure.
Panel A-5: Untreated galvanized surface (A); accelerated weathering, 6 months' exposure.
(Panels as shown are approximately two-thirds actual size.)



Panel Fe-B-1

Panel Fe-D-1

Panel Fe-C-1

Panel Fe-A-1

Figure 8.—Comparison of accelerated-weathering tests of steel panels subjected to treatments Fe-B, Fe-D, Fe-C, and Fe-A prior to painting with two coats of primer 1.

The top half of each panel is covered with one hard-drying outside white top coat.
 Panel Fe-B-1: Hot-dip phosphate treatment (Fe-B); accelerated weathering, 9 months' exposure.
 Panel Fe-D-1: Phosphate-chromate cold wash (Fe-D); accelerated weathering, 9 months' exposure.
 Panel Fe-C-1: Hot-dip chromic-acid treatment (Fe-C); accelerated weathering, 9 months' exposure.
 Panel Fe-A-1: Hydrochloric acid pickle (Fe-A); accelerated weathering, 9 months' exposure.
 (Panels as shown are approximately two-thirds actual size.)

stood up very well in the accelerated-weathering test, as shown by the appearance of panel B-5 in figure 7. After 6 months' exposure the top coat pulled the primer off slightly along the scratch, but all other areas were in good condition. Panel D-5 (fig. 7) is representative of a group of treatments (C, D, E, F, G, and K) in which the improvement over an untreated galvanized surface was very slight or entirely negligible. Treatments I and L showed no improvement over un-

treated galvanized surfaces in the accelerated-weathering tests. In figure 2 the two right-hand panels show primer 1 over the acid-dichromate treatment, L, as compared with the same primer on untreated galvanized steel. Although a much softer black top coat was used on panel L-1, no improvement was observed over the untreated panel A-1 exposed for a longer time.

Accelerated-weathering tests of steel panels completed to date include only one series in which all the surface

treatments listed have been represented. The results of this test (of 9 months' duration) are illustrated in figure 8, in which panel Fe-B-1 represents the hot-dip phosphate treatments Fe-B and Fe-H, which again stood up best. These treatments were followed closely by the phosphate-chromate cold washes Fe-D and Fe-E, represented in figure 8 by panel Fe-D-1. The hot-dip chromic-acid treatment Fe-C gave slight improvement over treatment Fe-A (panels Fe-C-1 and Fe-A-1, fig. 8). The primer used on these panels chalked badly in areas not covered with top coat. The lower parts of the panels therefore appear white except where the chalked material has been rubbed off by handling. The places which appear black should not be confused with the dark areas on the top half of the panels representing spots where the top coat cracked and flaked off and took the priming coat with it.

None of the other surface conditions listed for steel panels (treatment Fe, Fe-K, Fe-P, Fe-M, and Fe-S) has shown any improvement over treatment Fe-A (acid-pickle) in the one accelerated-weathering test that has been completed. Other tests are in progress.



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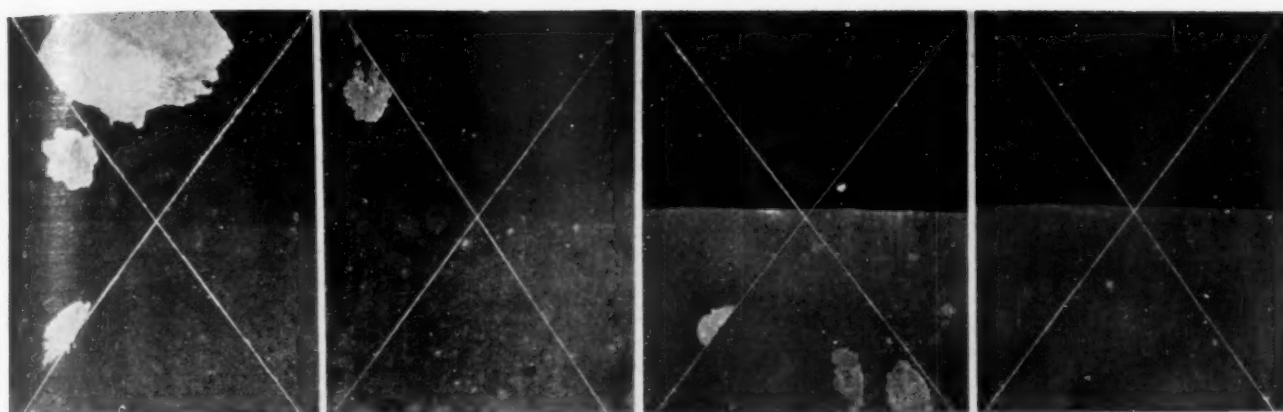
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Panel A-14

Panel H-14

Panel A-9

Panel H-9

Figure 9.—Comparison of condensation corrosion tests on hot-dip galvanized-steel panels subjected to treatments H and A prior to painting with two coats of primers 14 and 9.

The top half of each panel is covered with one soft-drying outside black top coat.
 Panel A-14: Primer 14 on untreated galvanized surface (A); condensation corrosion, 5 months' exposure.
 Panel H-14: Primer 14 on hot-dip phosphate treatment (H); condensation corrosion, 15 months' exposure.
 Panel A-9: Primer 9 on untreated galvanized surface (A); condensation corrosion, 10 months' exposure.
 Panel H-9: Primer 9 on hot-dip phosphate treatment (H); condensation corrosion, 16 months' exposure.
 (Panels as shown are approximately two-thirds actual size.)

3. Condensation Corrosion Tests

The condensation corrosion test was designed to simulate as nearly as possible the conditions that may occur in enclosed spaces, such as the interior of the walls of a house. The test consists essentially in exposing the prepared panels to the corrosive action of moisture condensed from a controlled atmosphere. The panels rest in a nearly horizontal position on the surface of a water tank forming the bottom of an insulated box through which air of controlled temperature and humidity is circulated. A test run includes a series of cycles, each of which embraces a condensation period of approximately 6 hours, an overnight period of 17 hours, during which the panels remain wet, and a final 1-hour drying period. During the condensation period the panels are maintained at a temperature of 15° to 20° C by water circulated through the tank, while the air circulated through the box is saturated at about 35° C. During the overnight period circulation of air is stopped, but the cabinet remains closed and the water tank is maintained at a temperature varying between 10° and 25° C by tap water. During the 1-hour drying period hot water is circulated through the tank and the panels are heated to about 40° C.

The principal factors causing deterioration of paint coatings in the condensation corrosion test are moisture penetration and rapid changes in temperature. Paints that would be expected to stand up best under these

conditions are those which resist moisture penetration or contain an inhibitive pigment and have good adhesion. This has been confirmed by the test results to date, in which failures have been due either to corrosion under the paint or to flaking through loss of adhesion.

Condensation corrosion tests so far have been confined to painted galvanized-steel panels. These panels include representatives of treatments A, H, J, and L. Of 14 different primers on untreated panels (treatment A) all but two have failed after periods varying from 5 to 16 months. Of 14 similar

primers applied over each of the hot-dip phosphate treatments H and J, only one of treatment H and one of treatment J have failed during this time. Neither of two primers over the acid-dichromate treatment L has failed after 16 months' exposure. In figure 9, primers 9 and 14 are shown on untreated galvanized-steel surfaces (panels A-9 and A-14) as they appeared after exposures of 10 and 5 months, respectively. Marked improvement was shown by the same primers over the hot-dip phosphate treatment H (panels H-9 and H-14, fig. 9) after exposures of 16 and 15 months, respectively.

(To be concluded in November issue)



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Shop Problems

Question. Will you please advise us of any simple method which you may know for preparing galvanized iron to insure good adhesion of the finish. We understand that sandblasting is quite effective, but we had in mind some sort of chemical solution which would be inexpensive and easy to use and not require any elaborate equipment.

Answer. Preparing galvanized iron for finishing involves two considerations, the removal of all oil, grease, dirt, etc. and obtaining a surface which provides good anchorage. If the finished surface is not exposed to the weather, a simple cleaning operation involving a solvent wash may be sufficient, providing, of course, the finish subsequently applied is designed for use on galvanized surfaces. A better procedure, however, is to follow the solvent cleaning with some kind of etch, for example, the application of a weak solution (four or five per cent by weight in water) of copper acetate.

To obtain both a cleaning and an etching action at the same time, the following solution has been suggested. Proportions are by volume.

Alcohol (denatured)	60 parts
Toluol	30 "
Carbon tetrachloride	5 "
Hydrochloric acid (concentrated commercial grade)	5 "

This solution should be liberally applied with a brush.

In addition to the above, there are a number of commercial treating processes on the market. For these, please refer to the 1940 edition of the Plating and Finishing Guidebook on pages 127 to 130 under the heading Metal Treating Processes.

Question. Can you tell me how to prevent skinning in a dip tank containing a baking enamel. If allowed to stand over night, even with a cover over the tank, quite a film forms. We have been emptying the tank, which measures approximately twenty-five inches square by ten inches deep, each time after use. However, this requires time, especially since we have found that the tank must be wiped out clean after it is drained.

Answer. A properly designed air tight tank cover, equipped with a sealing device and an air vent, should prevent skinning. If this by itself is not sufficient, you might try pouring a layer of the thinner used for the enamel on the surface.

Another method has also been successfully used, but necessitates the purchase of a tank of carbon dioxide. The tank of carbon dioxide is connected by a small pipe or hose to a point just above the level of the enamel. The valve is then opened very slightly to allow a small flow of gas to spread out over the surface, thus keeping the air from the material.

+

Question. I would like to obtain a little information regarding wood alcohol and denatured alcohol. Are these one and the same material? If not, wherein do they differ?

Answer. The terms wood and denatured apply to two different alcohols. The former material is methyl alcohol of greater or lesser purity obtained from the destructive distillation of wood, that is, by heating wood in a retort in the absence of air. It is wholly unfit for internal use.

Denatured alcohol, however, is ethyl or grain alcohol, either of the synthetic type or that obtained by fermentation, to which certain materials prescribed by the Department of Internal Revenue have been added.

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Organic Finishing Digest

Accelerated Weathering Tests for Paints and Varnishes. T. Landau. *Peintures, pigments, vernis*. 16, 134-6 (1939). Extended practical experience has shown that the value of the following method of accelerated paint exposure testing is quite high. The paint or lacquer film on an iron sheet is subjected to the following cycle of events: (1) alternate exposure to water and ultra-violet light on a rotating device, (2) immersion for some time in water, (3) exposure to humid air at 40° C., (4) a temperature of from minus 10 to minus 30° C., (5) outdoor air and darkness, (6) moist carbon dioxide and sulphur dioxide atmospheres. The above succession of tests is repeated on a weekly cycle until the film shows failure.

Raising by Nitrocellulose Lacquers of Artificial Resin Coats. G. Shroder. *Farben Chem.* 10, 161-3 (1939). If the priming coat on a metal surface is not merely softened but also swollen by the active solvents contained in the finishing coat of nitrocellulose lacquer, then the danger exists that the priming coat may be raised with resultant permanent unevenness. Since this kind of difficulty is most often encountered with primers formulated with large proportions of drying oils or oxygen convertible alkyds, the writer recommends that primers be formulated with film forming materials, e.g. polyvinyl resins which are not O_2 convertible.

Mottle Finish by Dipping. Z. F. Richardson, *Ind. Finishing*. 7, 19-21 (1940). Handles are dipped into mottling lacquer, drained then dipped into another lacquer (e.g. Aluminum lacquer). The mottle finish is produced by partial but rapid withdrawal from the tank followed by slow withdrawal. This leaves a band containing no aluminum finish. After drying, a clear lacquer top coat is added by machine dipping. Hexagonal and octagonal handles cause the lacquer to run to a sharp point.

Toxicity of Benzene. P. Angenot and R. Charlier, *Arch. maladies profes.* 2, 348-84 (1939). Pure benzene has a paralyzing effect on the peripheral vasomotor syndrome and also acts on the myocardium. It is less toxic than the commercial variety of benzene which contains certain unsaturated aliphatic compounds boiling at 80°C. These produce additional toxicity in the benzene.

Replacement of Metal Coatings by Painting. H. F. Sarx., *Angew. Chem.* 52, 715-7 (1939). The shortage of metals in Germany has caused a considerable decrease in the use of electroplated coatings of metals. The writer recommends the use of paints and lacquers for the purpose of metal coating as part of the German self sufficiency plan.

Diphenylpropane Resins for Varnishes. D. A. Kardashev., *Paint Varnish Prod. Man.* 20, 80-2 (1940). Original research in the formation of diphenylpropane—formalde-

hyde condensation products and their uses in coating compositions. Several useful varnish resins are formed with good film properties and rapid drying rates.

Mechanical and Physical Tests on Baked and other Varnish Films. J. Hekstra., *Chem.*

Weekblad 36, 629-34 (1939). Tests of various types of cellulose films used as insulating varnishes confirm previous experience that in general tensile strength increases with capacity for water absorption but dielectric losses are also increased.

Lacquered Black Plates for Containers to Save Tin. Steel. 33, 107 (1940). A short description of the use of lacquered plates in making containers to save tin.

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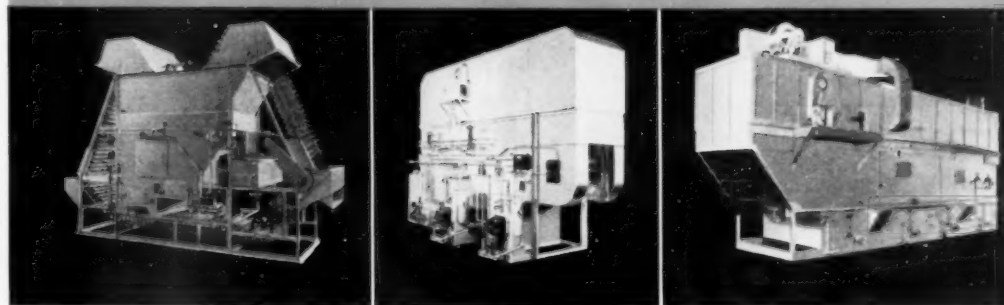
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NEW EQUIPMENT AND SUPPLIES

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Skin Guard

Magnus Chemical Co., Inc., Garwood, N. J., have recently published a description of their new "Skin-Gard" for protecting hands against irritating solutions.

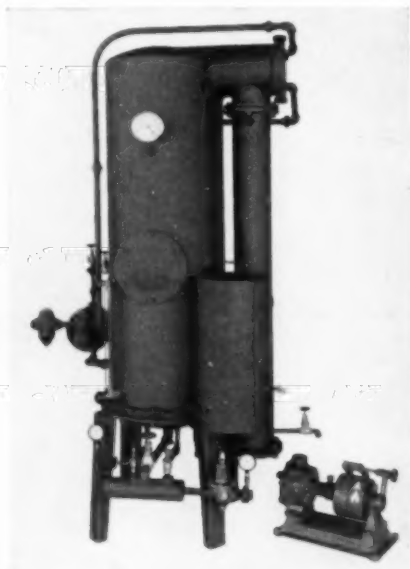
The material looks like an ordinary cream and is rubbed upon the skin before starting work. It dries quickly to form a thin, invisible film which is said to protect the skin against the substance with which the worker comes in contact. The material is easily removed by simple washing and all dirt, whether grease, paint, lacquer, etc., is removed with it. It is claimed that the use of the material prevents the pores of the skin from becoming clogged with grime, and thus helps to keep dirt and infectious oils from the skin.

It is stated to be particularly good for protection against solvents, such as gasoline, lacquer thinners, paint thinners, etc., which ordinarily remove oil from the surface of the skin, resulting in dry cracked hands. The "Skin-Gard" comes in two grades, namely, regular and water-proof. The water-proof grade is reported to effectively protect the skin against water, acid and alkaline solutions.

Solvent Still

Hills & Morrow, Hill St., Mishawaka, Ind., have announced the development of vacuum stills for reclaiming used solvents, such as naphtha, gasoline, benzol, paint and lacquer thinners.

The still is said to be built expressly for the low cost reclamation of spent solvents. It is automatic and operates efficiently at



Solvent Still

low steam. The still operates under a vacuum, resulting in a marked drop in the boiling point of the solvents, thus enabling low temperature steam to be used. The still operates continuously and automatically.

Infra-Red Reflectors

Wilson Lighting, Inc., 411 S. Clinton Street, Chicago, Ill., have issued literature describing their new infra-red drying reflectors.

These reflectors feature "Alzak" aluminum surface for reflection, and interlocking reflectors mounted on brackets for rigidity.

The company claims that the aluminum type reflectors are more nearly permanent than gold and have very nearly the same reflecting factor. The company's reflectors have surfaces which are very hard and can be safely cleaned with solvents or soap.

Apparatus for holding the bank of reflectors are available. The lamps are recommended for quick-drying of paints, lacquers, enamels and other applications where moisture or solvents must be removed. The units are said also to prevent blushing in lacquers, and to increase the speed of drying from five to nine times that of air-drying.

Each reflector is individually adjustable and reflector heat distribution can be regulated from circular to elongated or even an approximately square pattern.

Portable Air Compressor

The DeVilbiss Company, Toledo, Ohio, have announced the development of a new portable air compressor unit for operating small spray painting equipment. This unit is the successor of the company's former NK outfit, and this new unit is known as Type NKB.

The unit is rated at one-half horsepower, and is stated to be quiet in operation, and weighs 72 pounds. It is readily portable, being equipped with 4 rubber-tired swivel casters. Actual delivery is 4.55 C.F.M. at 45 pounds pressure. It holds the medium



Portable Air Compressor

spray guns at from 32 to 40 pounds, while the maximum pressure is 50 pounds.

I. P. C. Handbook Ready For Distribution

The Maintenance Painting Handbook, a 128 page compendium of solutions to difficult industrial painting problems, has been published, and is ready for distribution, by the Industrial Paint Clinic of Chicago, it is announced by the American-Marietta Company.

This Handbook, the first comprehensive guide of its kind in the paint industry, represents the accumulation of reports and records of technical paint questions extending over a period of 27 years. The findings in more than 100,000 actual cases have been compiled to give the results of first hand experience with paint problems that frequently baffle maintenance paint men.

Meticulously indexed for quick reference, the Handbook contains complete descriptions of surface preparation, methods of paint application, and types of paints that have proved successful under widely varied conditions. Included in the manual are concise discussions of painting methods for protection against weather, radical temperature changes, climate, moisture, acids, fresh and salt water, smoke, chemicals, dust abrasion, and many other hazards to industrial painting.

The manual also contains tables which will assist in estimating the quantity of paint needed to cover various regular and irregular surfaces, a factor that is of extreme importance to the paint purchaser.

M. J. Monahan, technical director of the Industrial Paint Clinic, said in discussing the compilation of the book, "Every technical paint question asked of and answered by the American-Marietta Company, and its predecessor, the American Asphalt Paint Company, since 1913 was taken from the files for careful editing and study.

"After months of careful sorting and classification, all usable material was condensed under specific headings. This was then turned over to our staff of chemists for scientific checking, and for the addition of information on the newest paint developments.

"Finally, the completed data were handed over to our copy writers for presentation in its published form.

"We feel that we can be justly proud of this contribution to industry."

The Industrial Painting Handbook will be distributed free of charge to industrialists and paint buyers. Requests for the manual may be addressed to the Industrial Paint Clinic, 43 East Ohio Street, Chicago, Illinois.

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The 92 Building Stones of the Universe

The isolation and identification of the 92 basic elements of matter—the building stones of our universe—were based on the perspective, perseverance and skill of scientists searching to unfold the unknown. Ancient men of science regarded matter as made up of indivisible entities called "atoms" but without the basic conception of elements as we understand them today. The elements known to the ancient world were: gold, silver, copper, iron, lead, tin, mercury, sulfur and carbon. Often compounds, such as water, were regarded as elements.

The men who contributed most to discoveries of chemistry during the first sixteen centuries after Christ were alchemists—seekers for the elusive and never-found way of turning base elements into gold. Their search for gold led them into many kinds of experiments and inevitably new elements were discovered. Albertus Magnus, German Dominican scholar of the 13th century, is credited with isolating arsenic, although the oxide of this metal was known since ancient times.

Paracelsus, the eccentric and boastful medical alchemist, is said to have made arsenic by heating eggshells and arsenic oxide. Antimony's discovery was obscure and the element was known in the 17th century. Bismuth was known in the 17th century and Caspar Neuman described its preparation. The story of the discovery of elemental phosphorus by Hennig Brandt is fascinating. In 1669, while trying to obtain gold from urine, Brandt separated a startling and strangely beautiful waxy substance that glowed in the dark—it was white phosphorus.

In the 18th century, nickel, cobalt and manganese were discovered in Sweden, and zinc was isolated. In this same century, Henry Cavendish, a brilliant but shy and awkward scientist, identified hydrogen as an element although it had been isolated long ago. Then followed the announcement by Daniel Rutherford, uncle of Sir Walter Scott, of nitrogen, an

incombustible component of air. Rutherford, as was frequently the case with scientists in his times, was not a professional chemist; he was a physician and botanist.

Leonardo da Vinci, at the beginning of the 16th century, recognized that air was not an element. Robert Hook in 1665 understood the nature of air, but it remained for Robert Priestly to fully explain the nature of air and oxygen. Priestly spent most of his years in England, but because of religious persecution, he migrated to America and is buried in the Quaker cemetery at Northumberland, Pa. The works of the renowned Swedish chemist, Carl Scheele, and those of Lavoisier, a French chemist, were of great significance. Lavoisier also laid the foundations for quantitative analysis. He was unfortunately guillotined during the French revolution and thus France lost one of its most valuable scientists.

In 1784, the d'Elhuyar brothers isolated the valuable element tungsten under the guidance of the noted Swedish scientist, Bergman. About the same time, Scheele and Peter Hjelm collaborated in producing metallic molybdenum. Five years later, Martin Klaproth, the most distinguished mineralogist and analyst of his time, worked with pitchblend and isolated what he thought was a new element which he called uranium in honor of Herschel's recent discovery of the planet Uranus. Many years later in 1841, Peligot showed that Klaproth's uranium was really an oxide of uranium.

Nicolas-Louis Vauquelin, French chemist, separated a new element, chromium, from a beautiful red mineral while working in Paris in 1797. It was named chromium because of the many colored compounds that it formed. In the same year, Vauquelin discovered the aluminum-like element, beryllium.

Two interesting non-metals, brothers of sulfur, namely selenium and tellurium, were discovered

near the end of the 18th century. Franz Mueller from Transylvania isolated a small amount of unknown material resembling antimony and sent it to the Swedish chemist, Bergman, for examination. Bergman found that it was not antimony, but it remained for Klaproth to name the element which he called "tellurium", meaning earth. Klaproth later isolated the element but unselfishly gave all credit for the discovery of tellurium to Mueller.

The great Swedish chemist, Joens Jakob Berzelius, owned shares in a sulfuric acid plant at Gripsholm that used as raw material, pyrite from the mine at Fahlun. In 1818 he isolated a new element from sulfuric acid, and because it resembled tellurium in its reactions, he called it "selenium." Berzelius also discovered the following important elements: silicon, thorium, cerium and zirconium.

The discovery of the element, columbium (niobium) is associated with Connecticut. Governor John Winthrop the Younger of Connecticut was an amateur mineralogist and found a rock fragment called "Columbite", near New London, Conn. This fragment was sent to the British Museum. It was in this fragment that Charles Hatchett in 1801, found an unknown metal now called "Columbium". Hatchett never succeeded in isolating metallic columbium and the separation eluded chemists until 1864. Tantalum, an element associated with columbium, was first discovered by Ekeberg in 1802 in a mineral from Finland. Because it was such a tantalizing task to track the element down, he called it "tantalum".

New elements were found in steady procession. Rhodium, palladium, osmium, iridium, ruthenium, platinum were added to the list of known elements. By the use of the newly discovered electric battery, Sir Humphrey Davy separated metallic sodium and potassium from fused salts. The alkali metal, lithium, was detected analytically in 1819 by Arfwedson and was finally isolated electrolytically by W. T. Brande and Davy. Davy, with the help of Berzelius, isolated pure calcium; barium, strontium, magnesium and cadmium were soon isolated.

We have discussed discoveries of elements by painstaking care, individual brilliance, new tools and by new methods. However, the work of Lothar Meyer and Dmitri Mendeleeff, in arranging the elements in periodic groups, pointed clearly to elements undiscovered. Mendeleeff boldly predicted the properties of three then unknown elements and these elements later proved to be gallium, scandium and germanium. The works of these two men enabled prediction of the properties of unknown elements, where they would likely be found, and whether any further elements should be expected.

The spectroscope invented by Kirchhoff and Bunsen enabled the discovery of many new elements including cesium, rubidium, thallium, and indium.

In addition, the spectroscope enabled the isolation of other elements from extremely dilute concentrations in the ore, similarly to the use made by the Curies of the electroscope, in isolating radium from pitchblend.

The 15 transition elements, namely, the rare earths with atomic numbers from 57 to 71, presented a difficult task for the research worker to isolate them. These elements in the group 3 of the periodic system, are formed as a result of the filling of an inner ring of electrons. Cerium was the first rare earth to be discovered and was isolated by Berzelius in 1804. Lanthanum, the second rare earth discovered, was isolated 35 years later by Mosander. Four years later yttrium, erbium and terbium were discovered by Mosander. In the latter half of the 19th century, seven more rare earth elements were discovered, and at the start of the century, europium, one of the least abundant of the rare earth elements, was isolated by Demarcay. Ytterbium was discovered in 1905, and in 1926, Hopkins and co-workers at the University of Illinois, by painstaking recrystallization of rare earth salts, discovered a rare earth element and called it "illinium".

In 1902, the Curies, after tedious extraction from pitchblend, announced the momentous discovery of radium.

In the last eighteen years, the remaining six undiscovered elements, have been announced as detected. Two elements, masurium and rhenium, were discovered in 1924, and in 1931, Allison and co-workers of the University of Alabama, announced the detection of the remaining undiscovered element, using magneto-optic methods, and called the new element, "alabamine", in honor of the State of Alabama.

Nuclear physics, whose early growth was associated largely with the work of Rutherford in England, has taken a new lease on life with the development of apparatus for producing the high electrically charged projectiles, such as protons or deuterons. Transmutation of elements on a small scale has become a fact, and for example, carbon and hydrogen have been made to form nitrogen. The disintegration of the atom has been done particularly with atoms of low atomic weight. The complexity of high atomic weight elements requires that extremely high potentials be used to penetrate the atom.

Thus it appears that the 92 elements predicted have been discovered. The chase has consumed the lives of many devoted to the fascinating task. We have yet much to know regarding these elements, the almost untold compounds that they can form, the many uses to which they can be put. The field is vast and endless and let us hope that progress in humanity can eventually grow to enable us to enjoy the benefits of science and not its potential horrors.

Hard Plating of Plastic Molds

By Arthur W. Logozzo

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Pittsfield, Mass.*

This paper was presented at the National Convention of the American Electroplaters' Society, held in June 1940 at Dayton, Ohio. Mr. Logozzo has had considerable experience with the subject of plating plastic molds. In this paper, he outlines the composition of plastics to account for the attack of various ingredients on the mold, the molding cycle and various reasons for plating. The polishing and plating cycles are outlined and definite recommendations are made as to solution composition, temperature and other pertinent factors.
—Ed.

THE introduction of plastics to the industrial world has broadened many fields of endeavor—designing, drafting, chemistry, metallurgy, engineering, toolmaking, and last but not most important to this gathering, plating. The first step in this field for platers is the chromium plating of plastic molds. A plated mold to the molder is what a well equipped car is to the car owner—a deluxe job.

There are two distinct phases to the modern industrial chromium plating field which are designated as:

1. Flash plating involving thicknesses up to 0.0005 (five ten thousandths) of an inch, and
2. Hard plating with thicknesses ranging from 0.0005 and upwards of 0.030 (thirty thousandths) of an inch. The pre-requisites of a chromium plated mold, namely, a minimum thickness of 0.001" (one thousandths) providing a file hard, wear resisting surface, inadvertently places it in the hard plating phase of the chromium-plating industry, thus the title of this paper.

Plastics Composition

To better acquaint us with reasons for plating molds, it may be beneficial to point out some of the constituents or basic materials used in the manufacture of plastic molding compounds. First, we have the binder which is defined as the material that holds plastics together and can represent from 30 to 99 per cent of a finished part. An analogy to illustrate this point can be made by using a simple concrete mixture where the cement is the binder. Binders include synthetic resins, cellulose compounds and substances such as phenol, furfural, phenol-formaldehyde, urea formaldehyde, vinyls, acetates, and polystyrenes. Some of these materials attack a steel mold surface, particularly thiourea formaldehyde. The attack of thiourea is very rapid producing an orange peel effect. Chromium plated molds are impervious to attack by any of the aforementioned substances.

Next comes the filler, ranging in proportions from 20 to 70 per cent admixed to the binder. The function of this material is to regulate density, give definite properties such as impact, flexural, tensile strength, water absorption,



Arthur W. Logozzo

shrinkage, dielectric, resistance to chemicals and heat resistance. These properties vary according to proportions used. Woodflour, graphite, cotton flock, rag, mica, asbestos, and charcoal are used as fillers. All of these materials have abrasive properties as well as fouling tendencies when molded. The plastics filler is analogous to the stone and sand aggregate used in concrete mixing.

Then comes the plasticizer, a material added to the compound to aid in controlling the type and rate of flow during molding. The most common plasticizers used are water, wax-oils, phosphates, phthalates, etc. with proportions up to one per cent on phenolics and 30 per cent on cellulose materials. Water or moisture accelerates the corrosion problem especially during hot molding.

Lubricants are added to the compound to help the parts extract from the mold. Calcium stearate, zinc stearate and vegetable waxes are used with proportions up to one per cent.

Coloring matter is added in the form of pigments and dyes to obtain those attractive shades and colors so popular in plastics today. Some of these materials are abrasive, especially some of the metallic oxides which are widely used. This chapter on plastic composition is presented strictly from a plater's standpoint and is not intended to deeply involve chemistry of plastic materials.

Molding Cycle

There are several methods of molding, the most important being injection, compression, and transfer. Injection

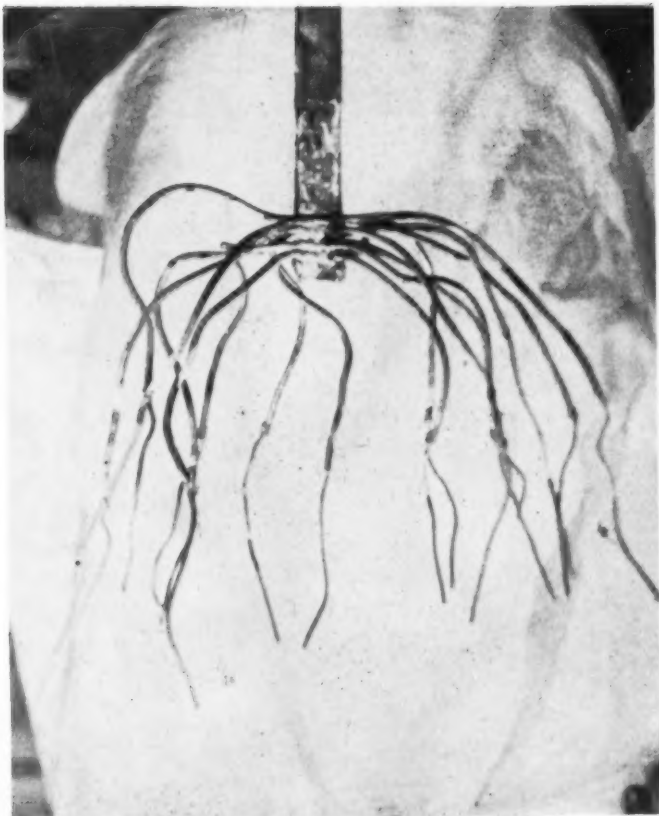


Fig. 1. The "Octopus" anode.

molding consists of forcing hot plastic materials under high pressure into a cold mold.

Compression molding consists of placing raw materials into a mold, closing the mold with low pressures, then applying heat and higher pressures over a definite interval of time during which curing takes place. After curing, pressure and heat are withdrawn, the mold opened and molded part removed.

Transfer molding endeavors to incorporate the more favorable features of the aforementioned methods—namely, high temperatures, high unit pressures on material along with maintenance of close tolerance molded parts.

Pressures necessary to insure a properly molded article normally run from one to four tons per square inch for

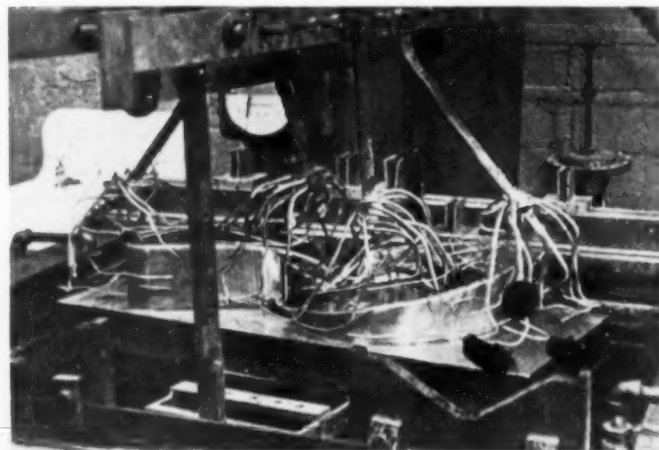


Fig. 2. A set-up showing "Octopus" anode to full advantage.



Fig. 3. Same set-up as Fig. 2 from another angle.

compression molding and up to ten tons per square inch for injection molding, depending upon the particular type of molding compound used.

Reasons for Plating

After viewing the composition of basic materials used in plastics manufacture and briefly touching the molding cycle, we find several problems confronting the molder, conditions that can be alleviated by the use of chromium plated molds.

Taken in the order of their importance they are as follows:

Wear—the harsh abrasives used under high pressures necessitate a good file-hard chromium. The close tolerances demanded of the plastic industry benefits by the plating of molds by preventing dimensional changes due to wear.

Sticking and fouling tendencies of compounds are greatly relieved and in many cases totally eliminated by the low coefficient of friction of a chromium plated mold surface. This factor also plays a prominent part in reducing the breaking-in time of a new mold from a matter of days or weeks to a few hours.

The corrosive agents found in some plastic compounds attack steel surfaces necessitating frequent polishing to maintain a uniform finish. The ability of chromium to resist wear, corrosion, etc., results in a uniform finish for the life of the mold provided the proper thickness is used which we now believe to be 0.001" minimum.

Gases of reactions formed during the molding cycle hasten the tendency to break down the surface contributing to pitting. All types of hot molding require high

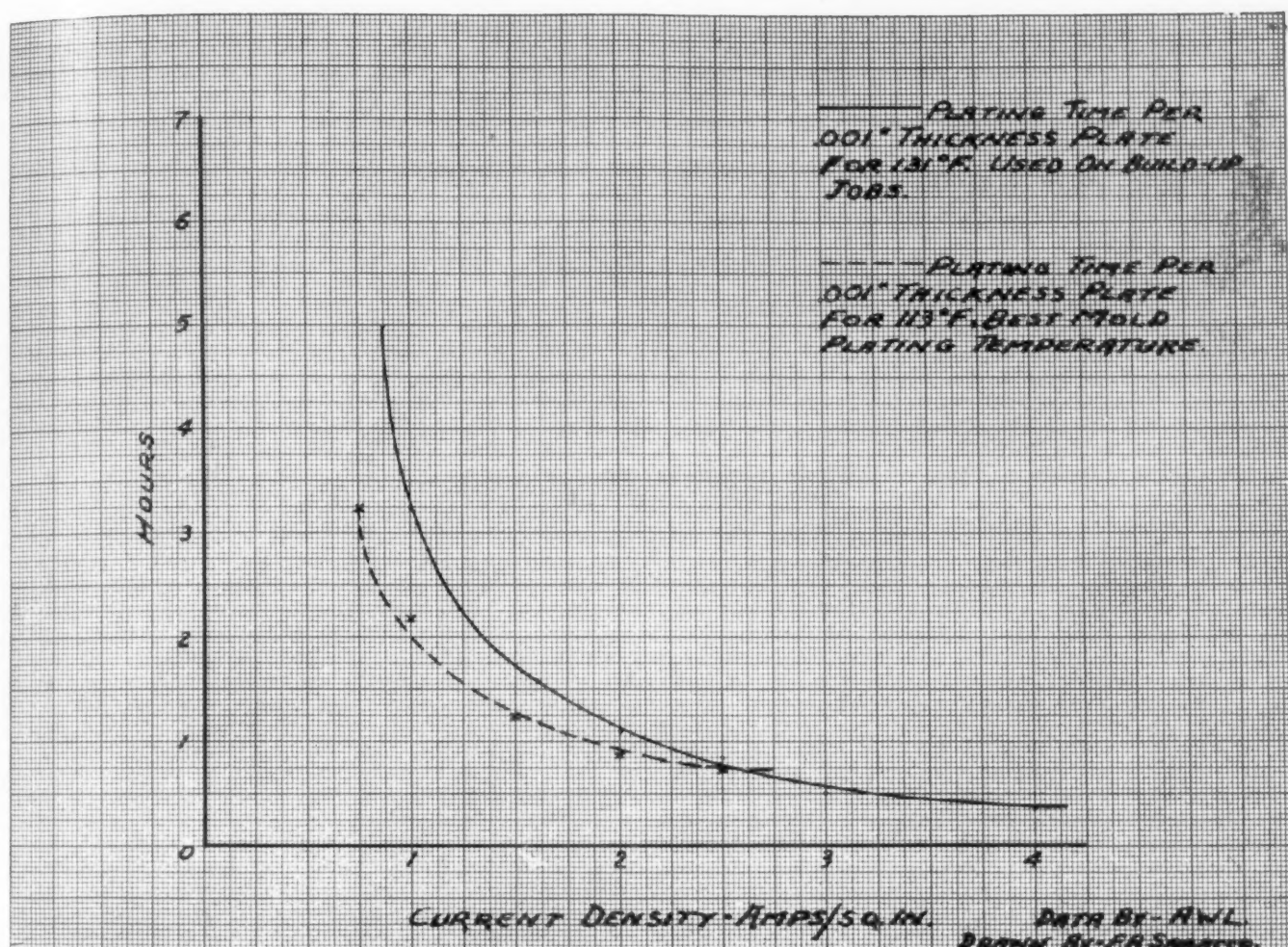


Fig. 4. Current density chart.

temperatures, upward of 300° F. for proper flow and curing, causing an oxidation of the steel surface. Plating will stop pitting and eliminate oxidation thus keeping the surface uniform besides facilitating flow of compound.

Polishing

After a mold has been cut or hobbled, generally from a chrome-nickel steel of the following proportions:

	S.A.E. 3312	S.A.E. 3110
C	0.17 (max.)	0.10
Mn	0.3	0.30
P	0.04	0.04
S	0.04	0.05
Ni	3.25-3.75	1.00-1.50
Cr	1.25-1.75	0.45-0.75

it is machined, filed and polished by hand, usually using a No. 240 grade Aloxite cloth. A hardening operation is employed to bring the hardness to a Rockwell C scale of 56 to 58. This provides an excellent base for a hard chromium plate. Now the mold is returned to the polishing bench for the final preparation of the surface. Aloxite cloth Nos. 180, 240 and 320 are used, starting with the coarse abrasive and gradually working into a finer grade so as to produce a fine-grained smooth surface. A double F emery powder with felt wheel is next

used, followed by a triple F emery powder which prepares the mold for the final rouge buffing.

Mold polishing is definitely a tool room operation. A mold is not finished until the surface has been completely prepared and this remains a tool room function because of sharp corners, edges, and very strict requirements concerning dimensions.

Plating Cycle

The first step in the plating room is a degreasing and pickling operation using a muriatic acid dip to remove the slight oxidation generally existing due to the long drawn-out polishing procedure.

A final polishing operation is employed to produce the highest possible lustre for an excellent base for plating. This is done by using a flexible hand polishing machine to which is attached soft bristle brushes. Aluminum oxide (Al_2O_3) and sperm oil are mixed to a paste to form the polishing compound. After the piece has been thoroughly gone over with the proper size and shape brushes, the work is washed in gasoline or some other good organic solvent. The polishing operation is now repeated using a dry aluminum oxide (Al_2O_3) powder which produces the lustre.

Each mold, due to its complicated structure presents a new problem as far as set-up is concerned. Any part of the mold coming in contact with the molding mate-

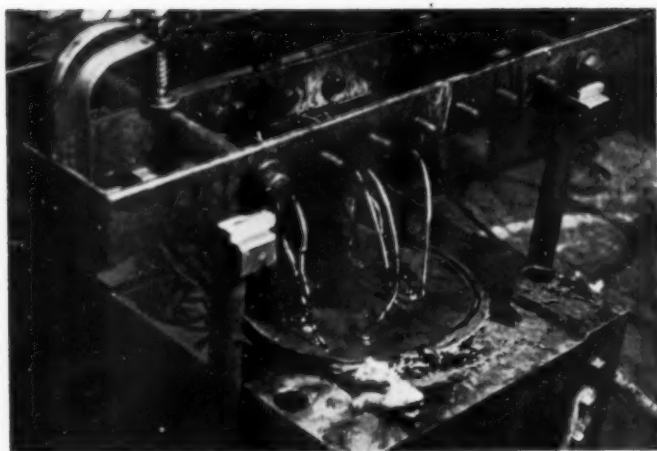


Fig. 5. A large mold being plated outside of tank. The cavity of mold constitutes the tank.

rial should be plated uniformly. This means that recesses (regardless of depth or shape), pins, sharp edges, or cutoffs and flash sections must be plated in the same operation. Outside portions of the mold are lacquered to confine the surface area to the important section.

The anode presents the most important and difficult phase of mold plating. Sheet lead or flat anodes, such as used for the general run of decorative chromium plating is absolutely out of the question. To form a template of the cavity or mold part has been tried in some quarters but is not logical considering the relatively poor throwing power of the chromium solutions. The "octopus" anode, however, such as we use extensively and successfully presents us with a ray of sunshine. This anode (illustrated) consists of a lead-coated copper conducting bar. The lead wires are welded to the lead-coated bar. Lighter wires (whichever size is desired) are welded to the ends of the heavier wire to insure firmness after these wires are placed where they will do the most good. These wires may be shaped to conform to slots, holes and recesses.

The mold must be set-up to permit a free flow of gas. No part of the molding surface should be flat otherwise a pitting of the deposit will occur due to the lethargy of hydrogen bubbles on a flat surface. Low points, or places harder to plate, must have the anode closer than high points to help equalize the current density. The high maneuverability makes the "octopus" anode very practical and desirable for these setups.

After the work surface has been prepared and the anode is in position, we are ready for our cleaning cycle. First, it is cleaned cathodically in a good alkaline solution—6 to 8 oz./gal., using 40 to 50 amps./sq. ft.—rinsed well in running cold water, then anodically treated in a 28 oz./gal. chromic acid solution 90 to 100 amps./sq. ft. with the temperature kept at 130 to 140° F. This treatment produces a fine microscopic etch insuring a perfect bond between the steel base and the chromium deposit. Because of the extremely high pressures used in plastic molding this bond is essential for successful mold plating. The microscopic etch is in keeping with the high reproducibility of chrome in that there is no pronounced distortion of the surface.

Without again rinsing, the work is put into the plating bath, the plating time being determined by the required thickness. (Illustrated) The plate should be bright or

slightly frosty when removed from the bath.

The physical characteristics of chromium should be kept in mind when applying current density. A file-hard minimum thickness of 0.001" should be the objective. This can be obtained only by using the proper current density, temperature, and closely controlling rate of deposition.

A milky deposit is objectionable and under no circumstances should be permitted to leave the plating room. After plating, the work is rinsed in cold water and neutralized in an alkaline bath to remove any chromic acid trapped in recesses, steamlines, etc.

The work is now ready for the final buffing operation which is accomplished by using felt cones and a good chrome rouge. The higher the finish, the greater the reduction in the breaking-in point of a new mold.

Solution

Of the two predominant solutions found in industrial chromium plating, namely, the 250 g/l and the 400 g/l with sulfate ratios 1 to 100 in proportion to CrO_3 in both instances, we find the 400 g/l solution has several distinct advantages for mold plating. The throwing power is superior and the finish slightly brighter. The heavier concentration is also advantageous because care need not be so frequent or exacting. Trivalent chromium is another important factor to be considered. The results are

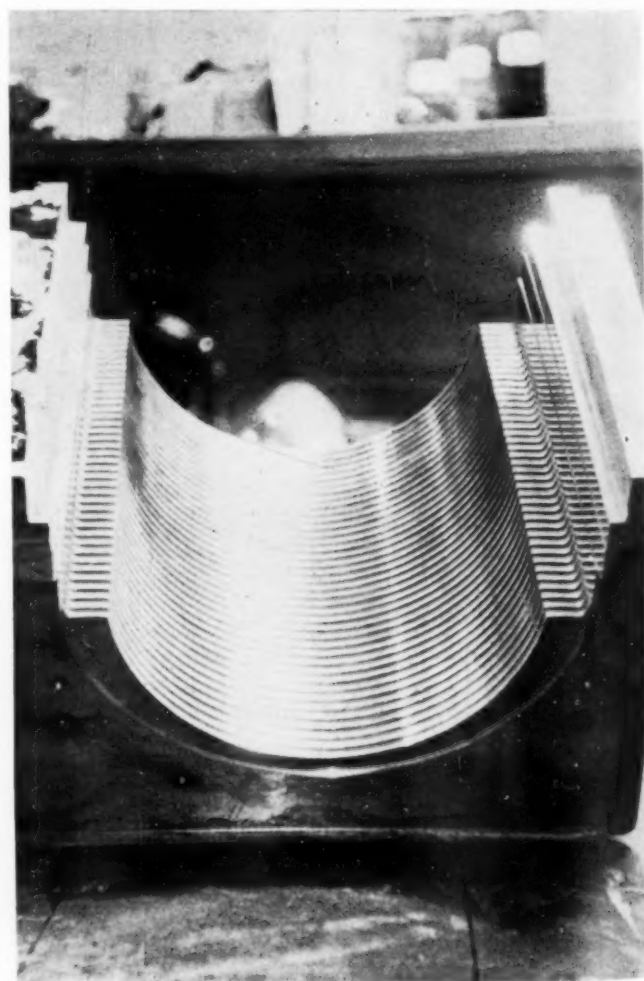


Fig. 6. Showing an intricate insert for a record rack. There are 40 slots all of which were plated in one operation.

excellent with trivalent chromium existing at 1% to 1.5% but from 2% and over, the throwing power and brightness are greatly impaired. It trivalent chromium is permitted to go too high, an intermittent flaking will occur. In other words, if three molds are plated simultaneously two are apt to be good and the third one flaked. Then again this condition will not exist for several loads. The more concentrated solution helps to keep this condition within bounds. The above statement however, must not be misunderstood. The 250 g/l solution is not considered as effective as the 400 g/l for mold plating but is not objectionable.

A temperature of 113° F. is recommended for this type of plating because of a good throwing power, and temperatures lower than this would represent a slower rate of deposition, increasing the time factor to obtain necessary thickness so essential for good wear-resisting chromium plated molds. Tests have also proven there is little or no difference in hardness between 113° F. and the higher temperatures used for rapid plating or build-up jobs. In fact the hard plating temperature range for industrial chromium is generally recognized as existing between 113° F. and 131° F. However, if temperatures higher than 113° F. were used for mold plating (particularly complicated pieces) there would be a tendency to reduce the uniformity of deposits. The low corners in deep recesses would receive milky deposits whereas the high points would have a tendency to build up because of the proportionate increase in current density to cope with the increase in temperature.

Other Uses for Hard Chrome in Plastic Industry

There are many other uses for hard chromium plating in the plastic industry aside from those already mentioned in this paper. The always essential salvage angle should perhaps come first on this list. In many cases it is much more economical, both from the financial and time-saving standpoint, to bring back to size by plating rather than build new parts for such articles as worn cavity sidewalls, knockout pins, hole forming pins, monogram pins plated to eliminate burr around monogram in molded parts, worn automatic machine parts, and insert holders. Curing forms, used to keep the proper dimensions of molded parts, are useless when worn below a certain size. These are brought back to size by plating and also increases the wearing surface. In many quarters the chromium plating of threaded parts is condemned. The threaded parts of a mold present an exception, however, and many worn molds of this character have been reclaimed by plating back to size. This list is at best only partial but serves to give a general idea of the numerous savings to be effected by the use of hard chromium.

The use of welding for changing dimensions, etc. is widely employed. This practice involves machining, rehardening and refinishing of the welded part. These extra operations can be eliminated by using a build-up of chromium and grinding to size.

The plating of taps, cutters, and in many cases drills

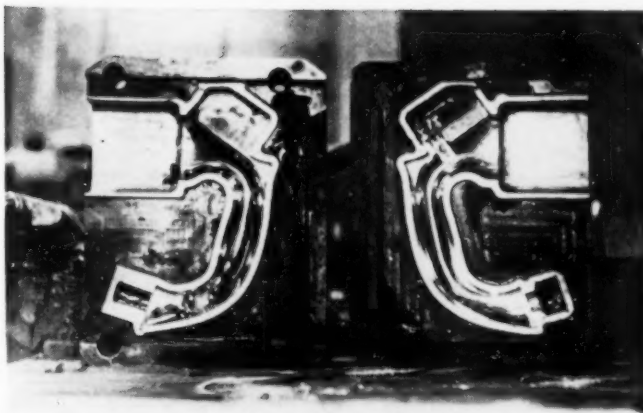


Fig. 7. Plated mold halves for molding flat-iron handles.

used in the cleaning and finishing of molded parts results in a much longer wearing life. In some cases where two thousand pieces were cleaned or tapped using a specially treated steel tap, ten thousand pieces were run using a plated tap. A minimum thickness of 0.0015" is recommended, however, using a bath temperature of 120° F. which produces an excellent chromium finish. Taps plated or otherwise, can be brought back to size when worn. Heat treating is suggested after plating tools to remove occluded hydrogen. This is done by using 300° F. and helps to eliminate chipping on sharp edges. No mention is made of heat treating molds because this is automatically taken care of when the mold is brought up to molding temperature.

Conclusion

After acquainting ourselves with some of the basic materials used in plastic molding and viewing the molding cycle we can appreciate what the molder is up against and readily understand why chromium plating is essential to the industry. Judging from the experience we have had with plated molds, we assume the following qualifications necessary for continued successful chrome plating of molds:

1. Correct hardness of base; Rockwell C56.
2. Highly polished, defect-free surface.
3. Perfect adhesion.
4. Uniform deposit.
5. Minimum thickness 0.001".
6. File hard surface.
7. Highly finished plated surface insuring a low coefficient of friction.

The advantages of plating molds taken from a molder's viewpoint may be summarized as follows:

1. Corrosion resistance.
2. Free extraction of molded part.
3. Higher finish of molded part.
4. Longer wearing life of mold.
5. Better flow of compound.
6. Uniformity of molded pieces over a period of time.

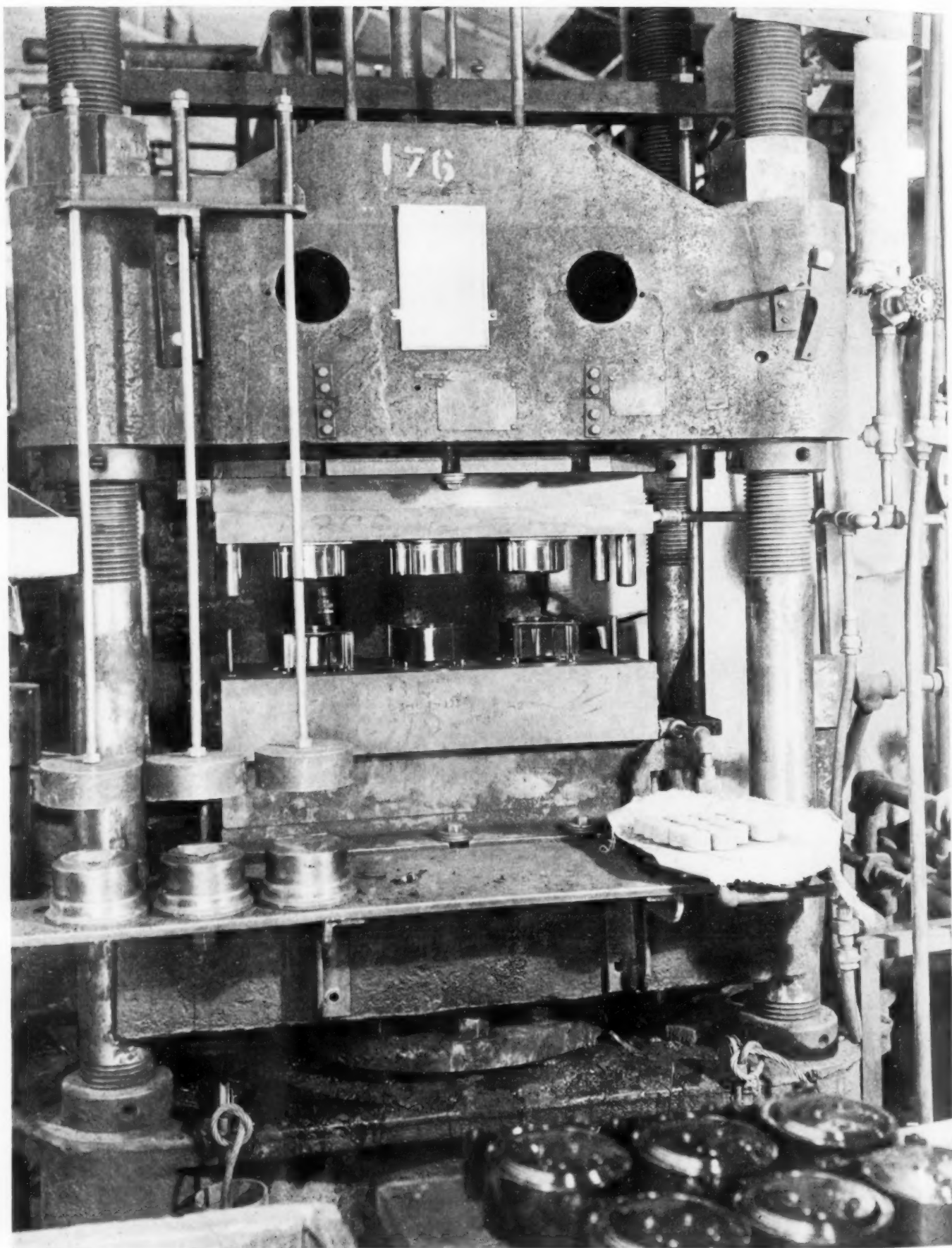


Fig. 8. A full view of plated cavities discharging molded parts. Note high finish on plungers and finished product.

The Reaction of Zinc and Iron In Hot-Dip Galvanizing

PART III

By Dr. Ing. Heinz Bablik

This is the third part of Dr. Bablik's paper on hot galvanizing. The effects of various additions of aluminum and tin to the zinc bath are shown. The effects of the iron base are also illustrated.

From Fig. 11 it is seen that even with an addition of 0.1 per cent aluminum the appearance of the crystals is appreciably influenced. The influence on the equilibrium conditions is shown by Fig. 12. If aluminum is present in the bath, the temperature at which the ζ phase no longer exists is still further lowered. At 435° C., the appearance of the alloy layers already resembles those formed in a bath of electrolytic zinc at over 500° C. Fig. 13 illustrates a further point of interest, in that an aluminum alloyed bath shows great irregularity in the coating. Side by side on a level surface places exist where all layers, "an" and "pal" and "ab", are present, and also places where only the "an" layer adheres strongly to the iron base.

Quite a different appearance results from a coating dipped in a bath containing tin. (Fig. 14). In contrast to the microsections of the aluminum alloyed coatings, we find here a closely packed "ab" layer which is now much thinner than before. Also the "pal" layer has not the predominant place it had in all the coatings described above. Instead of that there is a very thick "an" layer, not seen to such an extent in the other coatings. Also extremely obvious under the "an" layer is a further double layer of phases of which we are not yet able to give the chemical compositions, or their places in the equilibrium diagram. What we learn by this is, that the condition of diffusion, as well as the crystals formed, are appreciably influenced by an addition of tin. The same fact is to be expected from an addition of carbon to the iron. It is generally held that owing to its small volume, carbon will have the greatest influence on the conditions of diffusion. Observation has confirmed this. The solubility of iron in molten zinc (and consequently the thickness of the alloy layers) is very much increased if carbon is present.

For comparison, (Fig. 15) shows sections of galvanized sheets of which the percentages of carbon in the steel are those mentioned. The black line inside is the iron sheet and the white part the zinc coating. A fact to be remarked is that on the sample of 0.23 per cent C, only one side has the heavy coating. That may be due to the fact that the one side of the sheet no longer has,

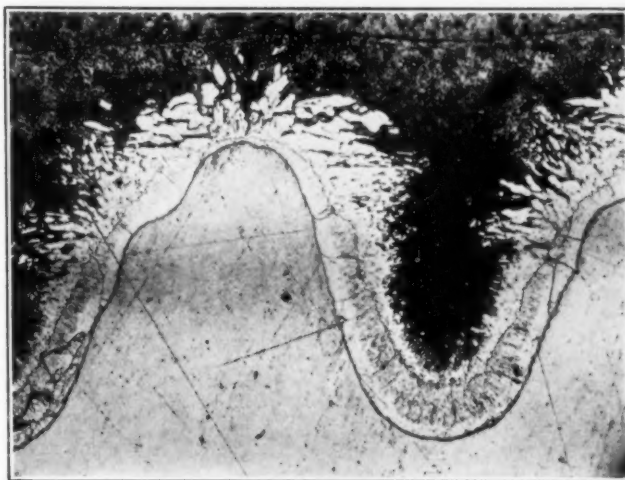


Fig. 10. Galvanized coating on a screw. Dipping time: 30 minutes. Dipping temperature: 440° C. 120X

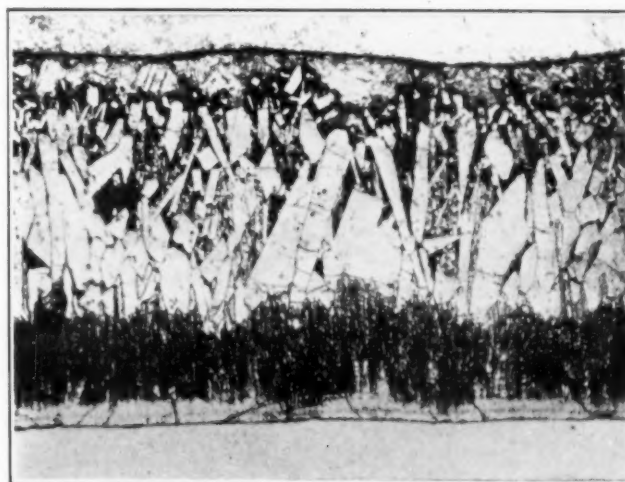


Fig. 11. Galvanized coating. Dipping time: 1 hour. Dipping temperature: 475° C. Bath: addition of 0.1% aluminum. 120X

in consequence of heavier oxidation, such a high content of carbon. In the samples with a still higher percentage of carbon, oxidation can be discounted as a probable influence. Here the real influence of carbon on both sides of the sheet is shown. Of course, under such conditions, the structure of the coating is also quite

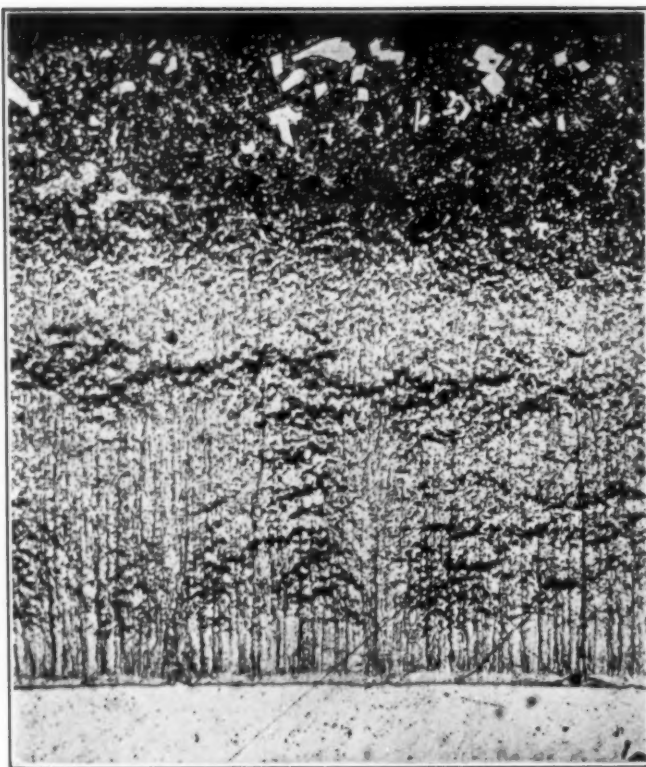


Fig. 12. Galvanized coating already at 485° C. in bath of 0.1% Al. The zeta phase has disappeared. Dipping time: 1 hour. 120X

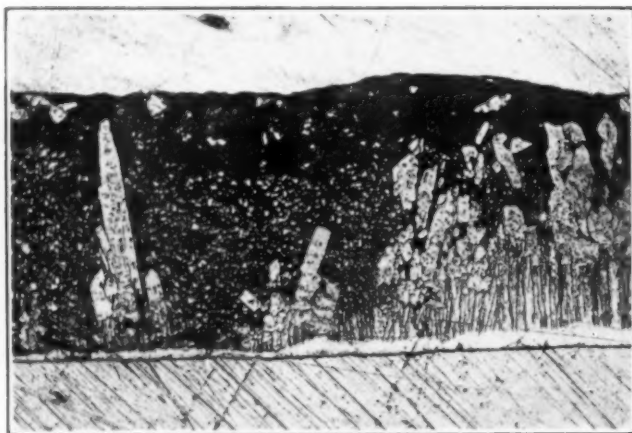


Fig. 13. Greater irregularity of the alloy layers in a bath with 0.2% Al. Dipping time: 4 hours. Dipping temperature: 440° C. 55X

different. No longer can definite alloy layers be seen, but in general only crystals of the ζ phase. An especially interesting fact is that in a bath with an addition of aluminum, iron with a high percentage of carbon will not have such a high solubility as the same iron would have in a bath of electrolytic zinc. In comparison we have found that the same iron with 0.1 per cent carbon has in a bath of electrolytic zinc a solubility ten times greater than in a bath with aluminum. (See Fig. 16.)

(To be concluded in December issue)

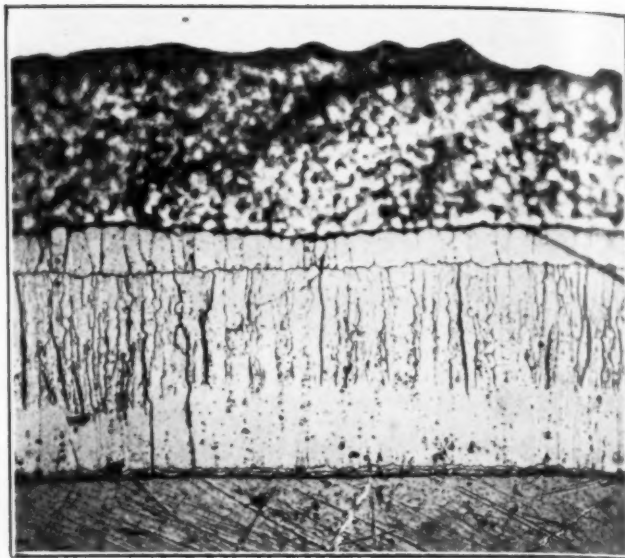


Fig. 14. Galvanized coating produced in a bath with 1% tin. Dipping time: 1 hour. Dipping temperature: 460° C. 350X

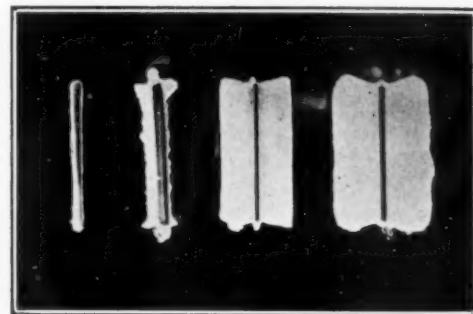


Fig. 15. Influence of carbon on the thickness of the coating. All samples the same dipping time: 1 hour. Dipping temperature: 450° C. Percentage of carbon: Armeo iron, 0.23%, 0.8%, 1.23%. Original size.



Fig. 16. Alloy layers in a coating on an iron with 0.23% carbon. Dipping time: 1 hour. Dipping temperature: 440° C. Bath: electrolytic zinc. 350X

A Study of Rhodium Plating

A Quantitative Study of the Electrodeposition of Rhodium from Sulfate and Phosphate Baths

By Mark Weisberg

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This is the first section of an extensive study of rhodium plating solutions. In this first installment, a survey of the literature on rhodium plating is made.
—Ed.

Introduction

RHODIUM is a hard, white metal which melts at 1900°C. It is a member of the platinum family, therefore its history and preparation are tied up intimately with the metallurgy of platinum. In the extraction of platinum from its ores, the filtrate from the ammonium-chloroplatinate precipitation contains the ammonium chlor-metallic salts of palladium, rhodium, iridium, and gold. A careful reworking of this filtrate produces, as one end-product, a finely divided metallic rhodium powder.

Rhodium, as a precious metal is about three times as expensive as gold. Unlike gold, its cost is based upon its valuable chemical and physical properties. Its high melting point, resistance to corrosion by any single acid, and its low volatility make it an attractive metal for the modern chemical engineer. Platinum-rhodium alloys which contain from 10 to 20% rhodium are stronger than platinum, have a higher melting point, a lower coefficient of electrical resistance, and equal resistance to oxidation¹. Such alloys find extensive use as electrodes, windings for high temperature resistance furnaces, and as a catalytic mass for the oxidation of ammonia to nitric acid².

Rhodium plating is a process which is of definite significance in modern electroplating practice. It has met with a very definite demand, especially in the reflector, jewelry and optical trades for the finishing of articles with a thin coat of a white metal which has a pleasing color and which will resist discoloration and abrasion and, at the same time, protect the base metal.

In the past few years, the practice of rhodium plating has narrowed down to the operation of two standard baths. The literature on rhodium plating is neither voluminous nor accurate. There are numerous references to plating procedures in the literature of electroplating but, in the main, these studies have been made under conditions which are not considered good commercial practice today. This previous work has been published in a wide assortment of periodicals and the history of the subject has not been compared and unified in one comprehensive study. It seems worth while, therefore, to correlate previous work in this field and follow this with a critical comparative study of the operating conditions of the two plating baths which are

in wide commercial use today. It is hoped that such information may encourage further work in this field and, at the same time, facilitate "trouble shooting" in present production.

Literature on rhodium plating may be divided into three parts, depending upon the chief topic of study. One group of workers has investigated the relative merits of different plating bath formulas and plating conditions. A second group has studied various methods of producing rhodium salts suitable for electroplating baths. A third group of investigators has interested itself in anodic reactions in rhodium plating baths. It seems wise, therefore, that each group be studied separately, even if it does necessitate some duplication of reference material. This study will be followed with some description of commercial plating units and the practical application of rhodium plating in every day use.

Joly and Leidie³ first studied the electrodeposition of rhodium. They plated the metal from a solution of rhodium trichloride, acidified with hydrochloric acid. They also studied deposition from solutions of sodium, potassium, and ammonium chlor-metallo salts which had been acidified with hydrochloric acid. Their baths contained less than four grams of metal per liter; plating temperatures ranged from 50-60°C.; current densities employed were from 0.05-0.1 amp. per sq. cm. Deposits were of fair quality and adhered well to the base metal. These workers claimed that the presence of either nitric or oxalic acids were detrimental to the plating process.

In 1901 Piccini and Marino⁴ electroplated rhodium from a solution of $\text{Rh}_2(\text{SO}_4)_3 \cdot \text{Cs}_2\text{SO}_4 \cdot 24 \text{H}_2\text{O}$. Later, Marino⁵ patented a bath using as electrolyte, sodium rhodium chloride to which was added magnesium-boro-citrate and a reducing agent such as gluco-citric or gluco-tartaric acids.

Langness⁶ discussed the use of a rotating "dish" anode in the electrolysis of several metallic salt solutions. This new anode is a platinum dish, 0.7 cm. diameter, 3 cm. deep. Its sides are provided with ten slits perpendicular to the edge; each slit is 1.8 cm. long and 0.5 cm. wide. This dish is alleged to insure free circulation of the liquid. The rapid precipitation of rhodium was best

1. Strauss, Trans. Electrochem. Soc., **68**, 41 (1935).

2. Fink and Lambros, *Ibid.*, **63**, 181 (1933); Met. Ind. (N. Y.), **31**, 208 (1933).

3. Joly and Leidie, Compt. rend., **112**, 793 (1891).

4. Piccini and Marino, Z. Anorg. Chem., **27**, 62 (1901).

5. Marino, U. S. Patent 1,073,432 (1913).

6. Langness, J. Am. Chem. Soc., **29**, 459 (1907).

accomplished from a solution of Na_2RhCl_6 to which a few drops of sulfuric acid had been added.

Keitel⁷ patented a rhodium plating bath which contained 2% rhodium-diammino-nitrite, 10% ammonium sulfate or nitrate, and 5% free ammonia. Plating temperatures were just short of boiling and necessitated frequent additions of both ammonia and nitrites.

Zschiegner⁸ prepared an electrolyte for depositing rhodium by boiling an aqueous solution of rhodium chloride with an excess of sodium nitrite until the liquid was colorless or yellow, then adding an excess of ammonia. He claims that the sodium nitrite reacts with rhodium chloride to form a double nitrite of the two metals. This, upon the subsequent addition of ammonium hydroxide, gives an ammino nitrite of rhodium in solution in the ammoniacal bath. From this bath, rhodium may be plated from hot solutions with from 4 to 10 volts, and current strengths of 0.05 to 0.2 amp. per sq. in., at temperatures of 75-95°C. The rhodium content of such a bath is specified at 2 grams per 150 cc. of solution. Insoluble anodes were employed.

The last two authors summarize their discoveries in a short article⁹. They again point out that rhodium may be plated from a bath prepared by nitrating rhodium salt and adding to the nitrated solution a slight excess of ammonia. They state, however, that "research on rhodium plating soon led into new channels and plating with rhodium nitrite was abandoned for the time being".

A French process plates a palladium-rhodium alloy from a solution of the alkali phosphates of the two metals and boric acid¹⁰.

Cinamon¹¹ reviewed the status of two baths generally in use for the plating of rhodium in 1932. He pointed out that the sulfate bath gives a more rapid plate, lower plating voltage, and is an easier bath to maintain. Its sodium salt is easier to prepare. Spray from such a bath is serious and injurious to workers, so suitable ventilation must be provided. Smaller anode areas may be used than for the phosphate bath because of the higher conductivity of the sulfate bath. The rhodium content of the sulfate bath is only half that of the phosphate bath. On the other hand, he points out that the phosphate bath produces a plate of better color, at a higher current efficiency, lower bath temperature, and yields sprays which are harmless to the operator.

Fink and Lambros¹² studied the deposition of rhodium from a variety of solutions. They dissolved rhodium hydroxide in sulfuric, phosphoric, hydrochloric, tartaric, citric, and nitric acids. They found that sulfuric acid solutions were very sensitive to changes in current density and acidity. Sodium sulfate additions stabilized the bath and produced very satisfactory deposits at 50°C. A bath made by dissolving rhodium hydroxide in phosphoric acid likewise was sensitive unless buffered with disodium phosphate. No satisfactory plate was obtained from rhodium chloride baths. A bath containing rhodium sulfate and phosphate, plus free sulfuric and phosphoric acids gave a very good deposit. Citric plus sulfuric acid solutions of rhodium gave good bright deposits at 50°C. Tartaric acid plus sulfuric acid solutions gave no satisfactory deposits. Nitric acid plus sulfuric acid gave a rhodium plating bath which produced good deposits at the same temperature.

In this connection it may be of interest to add that numerous attempts have been made by the author to use organic acid salts of rhodium, or organic acid electrolytes. These all proved unsuccessful. Even if a satisfactory plate was obtained, on standing for twenty-four hours, such baths would give either no deposit or a black deposit.

Shields¹³ patented three baths for plating rhodium. The first bath contains, per liter:

Rhodium sulfate, $[\text{Rh}_2(\text{SO}_4)_3 \cdot 12\text{H}_2\text{O}]$	20 gms.
Potassium aluminum sulfate	20 "
Sulfuric acid (92%)	50 "

and is operated at 4.5 volts and current strengths of 2 amps. per sq. cm. for 5 seconds on each article. A second bath specifies 1% rhodium chloride, 10% aluminum chloride and 10% free hydrochloric acid. This latter bath operates at 4 volts, a current strength of 2 amps. per sq. cm. and at 160°F. The third bath contains 1% rhodium phosphate and 10% free hydrochloric acid.

Atkinson and Raper¹⁴ recommend for their sulfate bath, a rhodium metal concentration of 2 grams per liter, a temperature of 40°C., and a current density of 5 amps. per sq. ft. Under these conditions they claim a cathode current efficiency of 45%. Insoluble platinum anodes were specified.

Powell and Davies¹⁵ claim a method for the deposition of rhodium from a plating bath which is a solution of a soluble double sodium nitrite of the metal. The solution is acidified slightly by a small quantity of a mineral acid, the anion of which is neither oxidized at the anode nor reduced at the cathode during the plating process. Sulfuric or phosphoric acids are mentioned. Operating conditions indicate a temperature of 65-80°C.

Cinamon¹⁶ discusses rhodium plating from phosphate and sulfate baths. He recommends a pH of 1.1 to 1.5 for the former and of less than 1 for the latter. He specifies, for the sulfate bath, a rhodium concentration of 1 gram and acid concentrations of from 4 to 40 grams per liter, a temperature of 80°C., and current strengths of from 0.1 to 2 amps. per square in. For phosphate baths, he recommends 2 grams of rhodium and 30 grams of phosphoric acid per liter, temperatures of 77-113°F., and current strengths not over 0.5 amp. per sq. in. He suggests the addition of 5 grams of sulfuric acid per gram of rhodium to increase the conductivity of the phosphate bath, but does not recommend it because of the added health hazard.

Schumpelt¹⁷ reviews the compounds used in rhodium plating and stresses the importance of both sulfate and phosphate baths. He recommends pH values of 0.5 to 1.5 and claims that the electrochemical behavior of baths so highly acid indicates the existence of several well defined and individual type compounds. He emphasizes the importance of thorough cleaning in alkaline

7. Keitel, U. S. Patent 1,779,436 (1930).

8. Zschiegner, U. S. Patent 1,779,457 (1930).

9. Keitel and Zschiegner, Trans. Electrochem. Soc. **59**, 138 (1931).

10. Precious Metal Developing Co., French Patent 711,081 (1931).

11. Cinamon, Brass World, **28**, 97 (1932).

12. See ref. (2).

13. Shields, U. S. Patent 1,949,131 (1934).

14. Atkinson and Raper, Met. Ind. (N. Y.), **32**, 119 (1934).

15. Powell and Davies, U. S. Patent 2,027,358 (1936).

16. Cinamon, Monthly Review (American Electroplaters' Soc.) **24**, (11), 838 (1937).

17. Schumpelt, Met. Cleaning and Finishing, **10**, 197 (1938).

cleaning solutions preparatory to plating. The phosphate bath is indicated especially for plating on tin and tin alloys.

Buss¹⁸ plates rhodium from a bath containing 50 cc. of 20% sulfuric acid, 50 cc. of 20% boric acid, and 10 grams of rhodium sulfate per liter. The bath is operated at room temperature with current strengths of 0.3 to 0.5 amp. per sq. dm. Deposition requires from 3-6 minutes.

As mentioned previously, rhodium is a member of the platinum family. Consequently, the preparation of rhodium salts which are suitable for electrolysis has occasioned considerable investigation. Atkinson and Raper¹⁹ list four general methods of preparing rhodium plating salts as follows: (a) fusion of finely divided rhodium with potassium acid sulfate to produce $\text{Rh}_2(\text{SO}_4)_3$; (b) heating a mixture of salt (NaCl) and metallic rhodium to dull redness in a stream of chlorine gas to produce RhCl_3 ; (c) heating a mixture of metallic rhodium and barium chloride to dull redness in a stream of chlorine gas. [The barium ion is then removed by treatment with sulfuric acid and the resulting compound is either RhCl_3 or $\text{Rh}_2(\text{SO}_4)_3$]; alloying rhodium with 10 parts of bismuth, then dissolving the alloy in aqua regia. These same investigators plated rhodium from a sulfate bath prepared as follows: rhodium chloride was treated with sodium nitrite and then ammonium chloride was added to precipitate ammonium rhodinitrite. This compound was fumed down with concentrated sulfuric acid and taken up in water. Keitel²⁰ suspended 2 grams of rhodium in the form of rhodium ammonium nitrite in 1 liter of 5% sulfuric acid, heating until solution was complete. Brown fumes of NO_2 were evolved, indicating the partial decomposition of the nitrite. When solution was complete, the bath was cooled to 50°C. and used as an electrolyte; plating conditions were: 20-30 amps. per sq. dm., voltage required—4 volts. Another procedure calls for boiling the insoluble rhodium ammonium nitrite in distilled water for 10-20 hours to form a water soluble acid ammonium rhodium nitrite. Keitel²¹ patented a process of renewing the rhodium deposited from a rhodium plating bath by adding rhodium ammonium nitrite to the bath which solution was kept ammoniacal. Label and Given²² state that rhodium is plated from a solution of hydrate or oxide in nitric acid. They mention that another acid such as sulfuric acid is valuable in increasing the conductivity of the electrolyte. Haas²³ precipitates rhodium by electrolysis of a solution containing rhodium borates or fluoborates and sulfuric acid. As an alternate, this solution may contain rhodium sulfate, boric acid and sulfuric acid. Cinamon²⁴ discusses the methods of converting rhodium metal into soluble rhodium compounds. For sodium rhodium chloride he heats an intimate mixture of finely divided rhodium and sodium chloride to redness and passes moist chlorine gas over the reaction mixture. Rhodium sulfate can be made by fusing rhodium with potassium sulfate, with a 40% yield. Rhodium, sulfuric acid and sodium sulfate, refluxed for a long time, yield an 80-90% conversion. Fusions of rhodium with zinc, lead, bismuth, alone or in various mixtures, gives rhodium alloys which may be dissolved in acids. He describes in detail a method of making rhodium sulfate or phosphate by means of a lead-rhodium alloy.

In general, the literature of rhodium plating specifies insoluble anodes. Platinum anodes are mentioned by numerous workers. Keitel²⁵ states that soluble anodes cannot be used at the present time, and that the metal content of the bath must be maintained by the addition of suitable salts. Koidzumi²⁶ examined the anodic behavior of rhodium in alkaline solutions (water, sodium hydroxide, methyl alcohol, ethyl alcohol). On the other hand, Buss²⁷ claims that rhodium can be dissolved electrolytically in hydrochloric acid solutions by both alternating and direct currents. He claims further that rhodium can be dissolved readily in sulfuric acid baths by use of an alternating current. Such solution is difficult when a direct current is used because of the passivity of rhodium.

This survey of the literature indicates the lack of correlation of our knowledge of rhodium plating. Despite this fact, commercial practice is quite standardized. Commercial sulfate baths today contain 1.5 grams per liter of rhodium sulfate and 4-5% free sulfuric acid. This acid accumulates until as much as 15-20 per cent is present. The phosphate bath is generally run with 2 grams of rhodium, as metal, per liter and 5% free phosphoric acid. Temperatures are from 90-120°F. The sulfate bath operates at 3-4 volts and the phosphate bath at 5-7 volts. Plating time is from 1-2 minutes.

Since no published quantitative data could be found in the literature, it is the purpose of this investigation to show the effects of temperature, current density, and the composition of the sulfate and phosphate baths on the cathode current efficiency and the character of the deposit.

18. Buss, Ger. Patent 637,777 (1938); British Pat. 440,938.

19. See footnote (14).

20. Keitel, U. S. Patent 2,067,534 (1937).

21. Keitel, see footnote (7).

22. Label and Given, French patent 803,273 (1936).

23. Haas, German Patent 637,777 (1926).

24. Cinamon, see footnote (16).

25. Keitel, see footnote (9).

26. Koidzumi, Mem. Coll. Kyoto, 17, 329 (1934); C. A., 30, 3334 (1934).

27. Buss, Gmud., 12, 35 (1938); C. A., 32, 8278 (1938).

(To be continued in December issue)

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EXHIBIT AT NATIONAL METAL SHOW



Above is the exhibit of N. Ransohoff, Inc. at the Metal Show held in Cleveland. Exhibited are a conveyor type washing machine and a one drum type washing and drying machine.

Abstracts of Papers Presented at Fall Electrochemical Society Meeting

THE THEORY OF THE POTENTIAL AND THE TECHNICAL PRACTICE OF ELECTRODEPOSITION

III. Linear Polarization on Some Line-Plane Systems

By CHARLES KASPER

Mainly a review of that portion of the theory of the potential which relates to the flow of current within a system, the conducting boundaries of which are not at uniform potential. When electrolytic baths, the conducting boundaries of which are non-uniform because of polarization, are considered in the light of this theory, a great deal of confusion is eliminated, and the parts played by various factors in determining the distribution of metal deposits over plated objects become apparent. One of the most difficult problems in electroplating is that of producing a deposit within the recesses of an object of complicated shape. It is easier to produce a deposit within recesses with some plating solutions than with others. Throwing power is usually treated in the literature of electroplating as a definite property of a solution without regard to the object to be plated. Throwing power involves several conditions, some of which are so related to the form and size of the object to be plated that they cannot be combined into a single property, the measurement of which will have any general significance.

If of two plating solutions of the same general type the one which has the higher polarization and conductivity also has the higher current efficiency at the lowest practicable current density, it will generally produce the more uniform coatings on irregularly-shaped objects, whatever their size or form. If polarization, conductivity, and current efficiency do not favor the same plating solution, it may be impossible to say which will give the more uniform deposit except by experiment with the objects to be plated.

Polarization always tends to make the deposit on irregular objects more uniform, and it is always of more importance in its effect on the smoothness of deposits and on irregularities of small size than on large shapes. The theory helps to explain the filling of pits or engraved lines.

The mathematical section contains or indicates the solving of the problems presented when polarization potentials are arbitrarily assigned to the simple boundaries considered in Paper II and also when polarization is assumed to be a linear function of current density for all but three of the same cases. These simplified cases are helpful in explaining the relations between the various factors which must be considered in practical electrodeposition.

THE THEORY OF THE POTENTIAL AND THE TECHNICAL PRACTICE OF ELECTRODEPOSITION

IV. The Flow between and to Circular Cylinders

By CHARLES KASPER

This is the fourth in a series of papers on the interrelation of the theory of the potential and the technical practice of electrodeposition. The first problem considered in this paper is the flow between two right circular cylinders that are not concentric. The second problem considered is that of flow to two circular cylinders at the same potential. These two problems have specific as well as general importance in the theory and practice of electrodeposition. There are also included three examples of right circular cylinders with linear polarization. One of these is important because it is a computation of the effect of both anode and cathode polarization.

ELECTRODEPOSITION OF ALLOYS, 1930 TO 1940

By CHARLES L. FAUST

This meeting comes very near the 100th anniversary of the electrodeposition of alloys, since the method for brass deposition

was discovered in 1841. There has been a steady increase in scientific and industrial interest in this field, especially during the last decade in which about half of the papers pertaining to alloy deposition have appeared. It may be pointed out that several prominent organizations are interested in alloy depositions, but for various reasons are not in a position to discuss the work. The most outstanding fact of recent years on alloy deposition is that not only color, but composition with narrow limits is maintained in large daily production. Alloy deposition requires close control, but no more so than that required in production plating of the several bright metals. Certainly electrodeposition of alloys should no longer be considered a laboratory curiosity.

GLYCERINE "FOOTS" AS BRIGHTENING AGENT IN CADMIUM CYANIDE BATHS

By F. C. MATHERS AND W. J. GUEST

Glycerine "foots", the residue remaining from the distillation of glycerine in soap manufacture, will produce bright cadmium plates from cadmium cyanide baths. Many other addition agents were tried but none was as good as the glycerine "foots".

THE ELECTROGALVANIZING OF WIRE

By ERNEST H. LYONS, JR.

In discussing recent developments in electrogalvanizing round steel wire, it is suggested that the difficulty in cleaning is the result of decomposition of drawing compounds due to elevated temperatures and pressures during drawing. Traces of copper may lead to hydrogen occlusion and brittle coatings, and iron salts contaminate coatings with iron. In the Bethanizing process, the bath contains sufficient acid to permit high current densities, while in the Meaker process the bath is nearly neutral but contains addition agents for this purpose. Contact difficulties, the use of zinc anodes, etc., are discussed. Estimated cost figures are given. Compared to hot galvanized wire, electrogalvanized wire is expected to have a longer life due to greater uniformity of coating as well as to heavier coatings available. Furthermore, the zinc coating is more ductile and adherent. Operating advantages and various tests for determining coating thickness are reviewed; the hydrochloric acid-antimony chloride strip test is recommended for general use.

THE ELECTRODEPOSITION OF INDIUM FROM SULFATE BATHS

By COLIN G. FINK AND RAYMOND H. LESTER

Extensive tests on indium sulfate plating baths have resulted in the following new data: Boric acid in an $\text{In}_2(\text{SO}_4)_3$ solution reduces the crystal size of the indium deposit and increases the current efficiency. The effect of adding NaOH to a solution containing $\text{In}_2(\text{SO}_4)_3$ and boric acid is to cause the current efficiency to go through a minimum; the quality of all deposits from this sodium containing solution is unsatisfactory. Aluminum sulfate when added to an $\text{In}_2(\text{SO}_4)_3$ solution reduces the crystal size of the indium deposit, producing the best quality plate we were able to obtain without the use of an addition agent. Gelatin in quantities of about 7.5 mg./L. reduces the current efficiency of the indium sulfate bath by about 20%, but greatly improves the quality of the deposit. Solutions of $\text{In}_2(\text{SO}_4)_3$, either with or without $\text{Al}_2(\text{SO}_4)_3$, yield their highest current efficiencies at an equivalent concentration of about 0.10 M In_2O_3 . The plating bath which gave the best indium deposit contained 0.10 M In_2O_3 ; 0.30 M H_2SO_4 ; 0.0173 M $\text{Al}_2(\text{SO}_4)_3$; and 0.0075 g./L. gelatin. Current density, 0.0325 amp./cm.²; bath temperature 26° C. Aluminum sulfate in the concentrations used appears to favorably affect the electrolyte layers next the cathode during electrolysis.

An equation of the form

$$\log (1 - e) I - m \log e I = b$$

in which m and b are constants, e the current efficiency, and I the current density in amp./cm.² accounts for the variation of e with I , the temperature and composition of the indium bath being constant. The agreement is within the experimental error for plating indium, and also for plating zinc and manganese. The above equation is able to account for a considerable number of experimental results on different metals, and, as is shown, has a sound basis to recommend it.

ADDITION AGENTS IN THE ELECTRODEPOSITION OF ZINC

By J. L. BRAY AND F. R. MORRAL

A group of amines was studied to determine their effect as addition agents in the electrodeposition of zinc. Amines of low number of carbon alkyl radicals showed a tendency toward good addition agent properties. The nitrogen in the amine in terms of grams N₂ per liter of electrolyte must be controlled so as to obtain the most beneficial effects of the addition agent. The length of the organic radical attached to the amine was found to have a decided influence. Other factors such as wetting properly and compound salt formation were studied and compared with the experimental data obtained with a few addition agents. These latter factors do not appear to be of the controlling type, such as the 3 factors above, for obtaining bright, ductile zinc deposits.

ELECTROLYTE FILMS IN ACID COPPER PLATING BATHS

By HAROLD J. READ AND A. KENNETH GRAHAM

A method of sampling the film of electrolyte immediately adjacent to a plating electrode has been developed. A small hole was drilled through the electrode, and electrolyte slowly siphoned through this hole while the plating operation was in progress. Experimental results are presented for the acid copper sulfate plating bath. The copper decrease and acid increase in the cathode film was studied under various conditions of current density, copper concentration, acid concentration and temperature. Variations in acid concentration were found to affect the film more than changes in copper concentration. An increase in temperature markedly decreases the difference between the film and main body concentrations. The ratio of copper to acid in the film has been considered, and the results interpreted from this point of view. The effect of the location of the sampling hole in the electrode on the composition of the film was also studied. On moving the sampling hole horizontally from the middle to the edge of the electrode, little difference in the composition of the film was noted. Large differences in the film composition were found when the samples were taken from the bottom, middle and top of the electrode, even though the electrolyte was sufficiently well stirred to avoid stratification.

EFFECT OF GLYCERINE ON THE THROWING POWER OF PLATING BATHS

By F. C. MATHERS AND W. J. GUEST

The purpose of this research was to determine the effect of glycerine upon the throwing power of plating solutions. Glycerine was found to increase the throwing power of zinc sulfate baths within a wide range of current densities and, moreover, the zinc deposits seemed to be improved in quality. This was the only metal on which the glycerine had a favorable effect. Glycerine reduced the throwing power of nickel baths within a wide range of current densities. The throwing power of copper sulfate solutions was reduced at high current densities but was increased somewhat at low current densities.

AN ELECTROLYTIC CHROMIUM PLATE THICKNESS TESTER

By STANLEY ANDERSON AND R. W. MANUEL

The tester described is based upon the principle that the ampere seconds required for the anodic dissolution of a given small area of chromium plating are directly proportional to the thickness of the plating. The areas stripped for test are circular and 4.8 or 2.4 mm. in diameter. The moment an area has been completely stripped the potential of the metal in this area changes

sharply. A solution of 1 N Na₃PO₄ and 1 N Na₂SO₄ is used as electrolyte.

THE DEPOSITION POTENTIALS OF METALS FROM FUSED ALKALI CHLORIDE-ALUMINUM CHLORIDE BATHS

By W. H. WADE, G. O. TWELLMAYER, S.J., AND L. F. YNTEMA

An auxiliary platinum reference electrode (together with a platinum cathode and a carbon anode) was used to determine the cathode potentials of hydrogen and of 6 of the common metals dissolved as chloride in a fused NaCl + KCl + AlCl₃ bath operated at 156° C. It was found that the order of deposition is the same as that in the voltaic series for aqueous 1.0 N sulfate solutions of these metals with the exception of copper, which is approximately 0.3 v. less noble than hydrogen: H, 0.87 v.; Co, -1.15; Ni, -1.16; Cu, -1.17; Fe, -1.47; Zn, -1.60; Mn, -1.91; Al, -2.02. These potential values apply to smooth bright deposits on a Pt cathode; dendritic or gray deposits were invariably obtained at somewhat higher potentials. At still higher potentials aluminum will deposit, besides the heavy metal added.

THE ELECTROLYTIC POLISHING OF STAINLESS STEELS

By H. H. UHLIG

The use of glycerine-phosphoric acid mixtures for electrolytically polishing 18/8 stainless steel is described. Optimum conditions to produce polish were determined with the aid of a photoelectric spectrophotometer. Maximum polish is obtained with an electrolyte consisting of approximately 42% H₃PO₄, 47% glycerine and 11% water by weight, used at 100° C. or higher and anode c.d. of at least 0.1 amp./sq. in. (1.5 amp./dm.²). Other organic additions to phosphoric acid likewise produce practical electrolytes. These substances consist, in general, of high boiling materials soluble in phosphoric acid containing one or more hydroxyl groups. Nickel, copper, chrome steels, 18/8 containing molybdenum, and mild steel, similar to 18/8, can also be polished in these organic solution-phosphoric acid electrolytes. Organic additions to phosphoric acid affect electrolytic polishing apparently by two independent mechanisms. The first is a change in electrolyte and anode phosphate film conductivity to produce optimum polish, and the second is a considerable retardation of localized pickling of the anode by acid independent of anodic solution. Stainless steel is much easier to polish electrolytically than iron.

AMPEROMETRIC TITRATIONS

By I. M. KOLTHOFF

In amperometric titrations the current passing through the titration cell is measured. These titrations require very little time and are applicable to very dilute solutions. Characteristic current-voltage curves are shown. It is expected that amperometric titrations will find at least as extensive application as potentiometric titrations do now in electro-analysis.

THE HYDROGEN ANODE

By M. DE KAY THOMPSON AND H. V. FAIRBANKS

Hydrogen anodes were made by bubbling hydrogen through the walls of tubes, closed at one end, made of the National Carbon Company's recently developed "grade 60" porous carbon, with platinum deposited electrolytically on the outer surface of the carbon or with platinum deposited in the pores of the carbon throughout its whole mass by the thermal decomposition of platonic chloride. When these platinized carbon anodes are electrolyzed in dilute hydrochloric acid, hydrogen gas enters the solution as hydrogen ions with a current efficiency that depends on the current density and on the rate of flow of hydrogen through the walls of the anodes. Both gray and black platinum gave about 100% anode current efficiency, up to 1.5 amp./dm.² and at a high rate of flow of hydrogen. A reduction in the rate of flow of hydrogen lowers the current efficiency. The material efficiency of hydrogen conversion to ions was not measured but was very low. The form of carbon used as air electrode in the Eveready air cell, waterproofed and platinized, gave a very low current efficiency. No experiments were made with waterproofed "grade 60" carbon.

The anode current efficiency in cupric chloride solutions and in nickel chloride solutions was found to be much lower than in hydrochloric acid solutions. The anodes are poisoned in copper cyanide solution but can be restored by heating them to 650° C. for two hours.

METALLIZED GLASS OXYGEN ELECTRODES

By HAROLD GRAEME BAIN

Metallized glass electrodes with films of Pt, Ir, Pd, Os, Rh, Ru, Ag and Au in various states—bright, black, etc., have been studied as oxygen electrodes in 3 electrolytes, solutions of H₂SO₄, KCl, and NaOH. No electrode has been found to give reproducible and constant theoretical values for the oxygen potential, although in a few cases potentials more noble than the theoretical single potential have been recorded, probably due to the presence of electromotively active oxides previously formed on these electrodes. Black osmium deposited on a base of bright platinum on glass has proved fairly reproducible and constant but not at the theoretical potential and only in acid and alkaline electrolytes. In neutral solution, palladium black deposited on a base of bright palladium on glass is fairly satisfactory, but again not at the theoretical oxygen potential. The phenomenon of motor-electrolytic-potential (m.e.p.) is very prominent and therefore has been studied with these electrodes since it appears to have considerable bearing on the reproducibility and constancy of these electrodes. It is considered that no single theory is at present capable of fully explaining the general behavior, including the m.e.p., of oxygen electrodes.

ELECTROCHEMICAL METHODS IN MICROCHEMISTRY

By E. B. ASHCRAFT

A review of the detection of the presence of Ag, Cu, Zn, As and other metals; and of the electrolytic quantitative determination of Cu, Hg, Ag, Ni, Sn, Zn and others, as well as a dozen different acids. Copper determinations have been made on samples weighing as little as 6 micrograms, the copper weighing approximately 1 microgram, with a precision better than 5%. Copper present in an electrolyte to the small extent of 0.5 p.p.m. has been quantitatively determined. Potentiometric titrations have been successfully carried out on electrolyte volumes as small as 0.25 ml. and with dilutions as low as 0.0001 *N*, with an accuracy of a few per cent. Arsenic, as little as 0.04 micrograms, can be detected conductometrically. Numerous electro-micro-chemical methods are discussed.

ELECTROCHEMICAL POTENTIAL DIFFERENCES AT THE BOUNDARY COPPER-INSULATING LIQUIDS

By ANDREW GEMANT

Electrochemical potential differences at the boundary copper-insulating liquids were measured by making use of an electrometer valve circuit and specially constructed cells of fairly high geometric capacity. Copper ions were brought into the liquids by dissolving cupric oleate or cupric acetate in the different solvents. Cells of the solvent-solution type showed definite and reproducible e.m.f.'s of the order of 100 millivolts. The sign of the e.m.f. was frequently opposite to that which would be expected from results with highly conducting solutions. This reversal could be explained by assuming extremely low activity coefficients in solvents of low dielectric constant, and also by large diffusion potentials. By slightly increasing the electrical conductivity, the reversed sign generally gave way to the normal one. Concentration cells of the ratio 1:10 show an e.m.f. of the expected order of 30 millivolts. By measuring one insulating liquid against another, a series can be established, arranged according to the electrolytic solution pressure of the metal in the respective liquid phases. The results are of sufficient interest to warrant further exploration of this new field.

A STUDY OF THE KINETICS OF THE REACTION IN THE ZINC-HYDROGEN IRREVERSIBLE CELL

By J. IRVING JOLLEY AND H. V. TARTAR

An apparatus was devised for determining the rate of metal-acid reactions in which the metal is made the anode of a metal-hydrogen irreversible cell. Using this type of cell, a study was

made of the kinetics of the dissolution of zinc in aqueous solutions of acids as affected by different factors such as electrolyte used, rotation of metal, temperature, and cell resistance. The similarity between the zinc-hydrogen irreversible cell and local couples is discussed. The rate of solution of zinc in acids is inversely proportional to the resistance of the solution, the resistance in the external circuit between the zinc and the platinum electrodes, and to some function of the acid concentration.

THE POROSITY OF LEAD STORAGE BATTERY PLATES

By ANNA P. HAUER

A method was developed by means of which the reactions at and in the negative plates of the lead storage battery could be studied. Thus, the changes in the physical structure of the plates due to certain chemical reactions were investigated. The pasted negative plate served as a microporous diaphragm. The electrolyte was forced through the pores of the active material and the time required for the passage of a measured volume of electrolyte was recorded. Keeping the pressure constant, a change in the rate of flow indicated a change in the structure of the paste. Although the flow rate values obtained cannot be converted into average pore size of any particular paste, nevertheless the method permits of a direct comparison and evaluation of pasted plates prepared by different methods or of plates at different stages of manufacture or of life. The method is of particular value in indicating under what particular conditions important changes in paste structure occur.

It is shown that during the first hours of formation the structure of the plates is radically changed and becomes, temporarily, almost impermeable. The structural changes during formation, especially toward the end of the process, are affected by the presence or absence of expanders. Curves showing the variations of the permeability of plates with and without expanders, during formation and after successive cycles, are presented. The conclusion is reached that the expander plays a very important function during the formation process.

AN ELECTROMETER TUBE FOR LABORATORY AND INDUSTRIAL USE

By LEE SUTHERLIN AND R. H. CHERRY

The tube described, which is rugged and has a long life, is suitable for detection and measurement of direct currents greater than 10⁻¹⁶ ampere. It can be used to detect and measure potentials in high resistance circuits to 0.1 millivolt or better. Its inherent stability practically eliminates frequent zero adjustments and its triode nature makes it usable in very simple circuits. Galvanometers suitable for operation with the tube are readily available for a wide range of sensitivity requirements.

PHASE SEGREGATION AND ITS RELATION TO THE PROPERTIES OF THE SYSTEM PALLADIUM-HYDROGEN

By DONALD P. SMITH

Upon experimental evidences to be found in its extensive literature, the system palladium-hydrogen is shown to differ from the ordinary binary metallic system in that its two solid phases, within the range of compositions where both are present, do not form an aggregate, but are wholly segregated. It is further shown that this fact accounts for anomalies in the two best-studied properties of the system, its dissociation tension and its electrical conductivity.

THE PRODUCTION OF DUCTILE TITANIUM

By W. KROLL

Titanium is a very active metal and special precautions are necessary to prepare it free from oxygen and nitrogen. TiCl₄ is reduced with pure magnesium in a molybdenum lined crucible, in the presence of pure argon, at a temperature of about 1,000° C. The metal is separated from magnesium salts by leaching and acid treatment. There is no alloying of titanium with magnesium. The powdered Ti metal is compressed into bars and melted in a special vacuum apparatus. The absence of all gases that might react with the metal is of special importance. After melting, the Ti is easily rolled hot. A strip less than 1 mm. thick can be bent cold without fracture.

Exhibits at Metal Exposition

Many firms in the plating and finishing field exhibited at the National Metal Show, held in October at Cleveland, Ohio. Three exhibits of companies in the plating field are shown below.

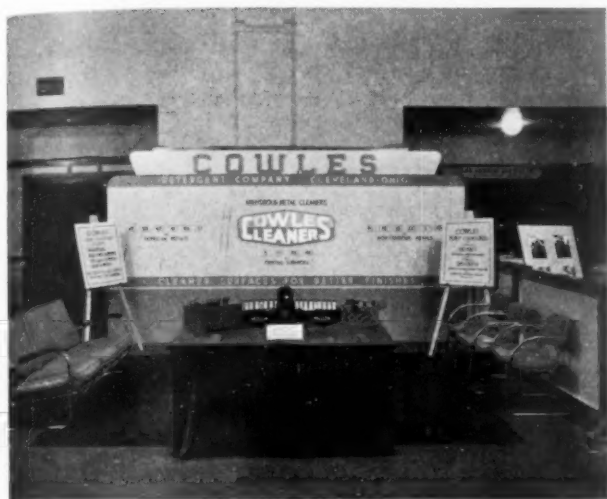


Exhibit of Cowles Detergent Co., Cleveland, Ohio. In attendance to explain the company's products were: A. L. Mercer, president; H. L. Trembicki, manager, Metal Cleaner Dept.; R. C. Burton, assistant manager, Metal Cleaner Dept.; G. P. Needham and Clyde E. Lowe, salesmen.



Shown at left are the exhibits of Matchless Metal Polish Co., Chicago, and Advance Polishing Wheels, Inc., Chicago. Buffing compositions and a new patented "Perma-Core" buff were illustrated. In attendance were: J. J. Manderscheid, president; Glenn Cannon, secretary-treasurer; B. R. Boyd, Detroit manager, and C. Potter, Cleveland manager.



Shown at left is exhibit of Chas. F. L'Hommedieu & Sons Co., Chicago, Ill. Four different models of the company's streamlined variable speed lathes were shown. Mechanical plating barrels for large production and midget and portable barrels for small production were also exhibited. Other products shown were tumbling barrels, rheostats and buffs and compounds. In attendance were: A. W. L'Hommedieu, president; S. L. Cole, sales manager; H. M. Writer, John Rogers, and W. R. Shields, representatives.

Detinning

Q. I would like to secure some information on detinning, and in fact, how to recover tin from cans and waste products. What kind of equipment is required and what is the percentage of recovery from one ton of cans.

A. *Alkaline electrolytic detinning:* Some of the most successful detinning plants in operation use the alkaline electrolytic process. This method consists essentially of electrolyzing the tinplate scrap at the anode in a bath of caustic soda and depositing spongy metallic tin at the cathode. Dr. C. L. Mantell gives the following figures in one modern plant:

Current—1,500 amperes.

Cells—6 baskets per cell, 70-75 lb. of scrap per basket.

Electrical connection—6 cells in series, 9-12 volts across the system or about 1.5 volts per cell.

Scrap—2% tin approximately.

Operating time—22 hrs. a day, 350 days per yr.

Detinning time—3 hrs., entire set of baskets per cell changed.

Output—3000 tons detinned per yr., 47.5 tons tin produced in one year.

The detinned scrap is suitable for making open hearth steel.

Acid electrolysis: Among the acid electrolytes for detinning, use has been made of sulfuric acid, hydrochloric acid, acid sulfates and chlorides. Gutensohn patented the use of sulfuric acid (German patent 12,883).

Chlorine process: In the Goldschmidt process, chlorine is introduced into the detinning chamber under pressure. The dry tin scrap is put into large cylindrical containers, either in more or less loose form or compressed into baskets. These containers, after being filled, are closed tightly. Dry chlorine is then introduced. The heat of the reaction of the chlorine on the tin is dissipated by outside cooling of the reaction chamber. After detinning has been completed, the remaining gases are drawn off by suction, along with any volatilized stannic chloride, and the detinned bales of scrap, washed and dried. The detinned scrap is then ready for sale.

The cost of handling a ton of tin scrap in process, including all labor, interest, taxes, depreciation, materials (as chlorine) repair, and maintenance is just about equal to the amount obtained per ton of detinned scrap when it is sold as baled scrap on the open market. This cost of handling does not include the nominal cost of the original tinplate scrap.

Technical Advisor For November Issue

WALLACE G. IMHOFF

President,

Wallace G. Imhoff Co.,

Vineland, N. J.

The values obtained then for the stannic chloride produced (or the tin recovered from such) are on the profit side of the ledger. There will be consumed approximately 80 to 100 lb. of chlorine per ton of tinplate of the quality and weight of tin coating on tinplate commonly used for tin cans. Note: all of the above data and information is by C. L. Mantell in his book on Tin, chapter 17.

Smith's College Chemistry states on page 651—"tin is sufficiently valuable to render the detinning of scrap tinplate from can factories, bearing 3 to 5 per cent tin, a paying process. In the Goldschmidt process the scrap is cleaned, dried and exposed to dry chlorine, which converts the tin into liquid stannic chloride, SnCl_4 , but leaves the iron unaffected".

A method proposed by Clarke for the determination of tin yield by the loss of weight after dissolution of both free and alloyed tin in hydrochloric acid containing antimony trichloride as the restrainer is mentioned in Series A No. 37 publication of the International Tin Research & Development Council.

The stripping of hot-dipped tin coatings from steel by the hydrochloric acid-antimony trichloride method is as follows: the material containing the tin coating to be stripped is immersed in an antimony trichloride reagent. The hydrochloric acid is of a specific gravity of 1.146 and is prepared by mixing 5 volumes of concentrated acid (sp. gr. 1.18) with 1 volume of water. The stripping reagent consists of 2.7 oz. of antimony trioxide dissolved in a gallon of this acid (or 20 g. dissolved in a liter). The thin commercial tin coatings dissolve in two minutes. A correction of 0.000004" is subtracted from the calculated thickness, as an allowance for the small amount of iron dissolved.

Methods mentioned in the literature for the practical detinning of plates are: (1) electrolytic alkaline process, (2) chlorine

process and (3) alkaline chemical processes.

In the first of these methods, the electrolyte (a solution of caustic soda, sodium stannate with or without the addition of sodium chloride, and the like) is contained in an iron vat, while the sheet metal scrap is in baskets connected with the anode. The bath temperature is 70° C. (158° F.), voltage about 2 (depending upon the bath composition), and current density approximately 10 amp. per sq. ft. Electrolysis takes place from 2 to 7 hrs. The tin deposits as a metallic sponge on the cathode, but a small part of it goes into solution as sodium stannate.

The electrolyte is continuously circulated and is regenerated periodically. Scrap contaminated with varnish, ink or organic compounds, must be cleaned with alkali and steam, washed and dried, before being electrolyzed.

Still another method of detinning is discussed in *The Iron Age*, March 5, 1931, p. 765 under the title of "Detinning Scrap by a New Process." It is as follows:

"A new process for detinning scrap tinplate is discussed by W. W. Scott and N. E. Davis in *Industrial & Engineering Chemistry* for August, 1930. It is based on the fact that dilute solutions of tartaric acid dissolve tin in the presence of an excess of air or oxygen while the iron is unattacked.

The detinning apparatus used consists of a perforated steel cylinder which contains the tin plate scrap. The cylinder is turned on a steel shaft which passes through the length of the cylinder and detinning tank. In the detinning process, the solution level is regulated to cover about one-third the cross sectional area of the cylinder. The scrap is subjected to the alternate action of acid and air. Three hours are found to be the most efficient length of time to conduct detinning and the acid is most effective at 5% concentration.

After detinning, the solution contains stannous tartrate. The tin may be recovered from the solution by precipitation as sulfide with hydrogen sulfide. The tin from the stannous tartrate is replaced by the hydrogen from the hydrogen sulfide and tartaric acid is recovered. There is a slight loss of tartaric acid in this reaction owing to decomposition, which is about 0.10 gram of acid per gram of tin recovered.

The tin sulfide may be converted into chloride by treating with hydrochloric acid. The detinned scrap contains about 0.10% tin which is sufficiently low to render it suitable for steel melting scrap".

Fundamentals of Science Relating to Electroplating

Thus the symbol for mercury is Hg from the Greek "hydrargyros" meaning liquid-silver, an obvious name for silver to the ancient Greeks. The name quick-silver comes from its Latin equivalent "argentum vivum" meaning live or "quick" silver. The symbols for many of the elements are given in Table II, where their valences are also shown. A combination of symbols i.e. the group showing the proper composition of a molecule or of a radical, is called a *formula*, and formulae of some radicals are also included in Table II.

It should now be possible for any reader to write the correct formulae of many compounds and compute the composition of its constituents. Since this is very important, several examples will be given.

1. *Copper cyanide for plating.* From Table II it is seen that the symbol for copper is Cu and that in a cyanide plating bath its valence is +1. Also, it is seen that cyanide is made up of carbon and nitrogen, C and N, and that the formula of this radical is CN with a valence of -1. Since the valence is 1 for both the copper and the cyanide, one unit of each will be necessary for combination i.e. the formula of copper cyanide is CuCN. From Table I the atomic weights are, respectively, 63.6, 12.0 and 14.0 and the molecular weight of the compound is, therefore, their sum or 89.6. The percentage of copper in pure copper cyanide is, therefore, 63.6/89.6 or 71.0%.

2. *Copper sulfate for plating.* Table II tells us that copper in an acid bath has a valence of +2 and that the sulfate radical SO_4 has a valence of -2. Taking one unit of each, therefore, to balance each other, the formula of copper sulfate is CuSO_4 . Now actually copper sulfate as commonly purchased always contains some water combined with it. This water is closely held to it and is not the same as loosely held water such as external moisture. The combined water is always present in the ratio of 5 molecules of water to 1 molecule of copper sulfate. The complete formula of the usual copper sulfate is written, therefore $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ where H_2O is the formula for water and where the figure 1 is understood (but never written) before the molecule CuSO_4 . The molecular weight of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is therefore computed as follows:

1 atom Cu	63.6	2 atoms H	2.0
1 " S	32.1	1 atom O	16.0
4 atoms O	64.0		
		1 H_2O	18.0
1 CuSO_4	159.7	5 H_2O	90.0

This is the third chapter in the series of articles relating to the fundamentals of science which pertain to electroplating. Formula calculations and combining data are given.

Molecular weight (M.W.) of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ = 159.7 + 90.0 = 249.7.

Per cent copper in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ = 63.6/249.7 = 25.5%.

3. *Zinc cyanide.* From Table II we see that zinc has the symbol Zn and a valence of +2. Since cyanide (CN) has a valence of -1, we must use double

the CN for each Zn, so that the formula for zinc cyanide is written $\text{Zn}(\text{CN})_2$. The subscript 2 applies only to the CN which is always put in parentheses in such cases. To find the molecular weight:

1 atom C	12.0	1 atom Zn	65.4
1 " N	14.0	2 atoms CN	52.0
1 CN	26.00	M.W. $\text{Zn}(\text{CN})_2$	
2 CN	52.00		117.4

Per cent zinc in zinc cyanide = 65.4/117 = 55.8%.

Table II

Name	Symbol	Atomic weight	Valence
Aluminum	Al	27.0	+3
Antimony	Sb	121.8	+3 or +5
Arsenic	As	74.9	+3 or +5
Barium	Ba	137.4	+2
Beryllium	Be	9.0	+2
Bismuth	Bi	209.0	+3 or +5
Boron	B	10.8	+3
Bromine	Br	79.9	-1, +1, +3, +5, or +7
Cadmium	Cd	112.4	+2
Carbon	C	12.0	+4
Chlorine	Cl	35.5	-1 as chloride +1, +3, +5, or +7 otherwise
Chromium	Cr	52.0	+6 in chromic acid +2 or +3 otherwise
Cobalt	Co	58.9	+2 or +3 +2 in plating solutions
Copper	Cu	63.6	+1 in cyanide plating solutions, +2 in acid plating solutions
Fluorine	F	19.0	-1
Gallium	Ga	69.7	+2 or +3
Germanium	Ge	72.6	+4
Gold	Au	197.2	+1 or +3 +1 in cyanide plating solutions
Hydrogen	H	1.0	+1
Indium	In	114.8	+3
Iodine	I	126.9	-1 as iodide +3, +5, or +7 otherwise
Iridium	Ir	193.1	+3 or +4
Iron	Fe	55.8	+2 as ferrous +3 as ferric
Lead	Pb	207.2	+2 or +4 +2 in plating solutions
Lithium	Li	6.9	+1
Magnesium	Mg	24.3	+2
Manganese	Mn	54.9	+2, +4, +6, or +7
Mercury	Hg	200.6	+1 or +2
Molybdenum	Mo	96.0	+3, +4, or +6
Nickel	Ni	58.7	+2 or +3 +2 in plating solutions
Nitrogen	N	14.0	-3, +1, +2, +3, +4, or +5

Table II (Cont.)

Name	Symbol	Atomic weight	Valence
Oxygen	O	16.0	-2
Palladium	Pd	106.7	+2 or +4
Phosphorous	P	31.0	+2 in plating solutions
Platinum	Pt	195.2	+3 or +5
			+2 or +4
			+2 or +4 in plating solutions
Potassium	K	39.1	+1
Radium	Ra	226.0	+2
Rhodium	Rh	102.9	+3
Selenium	Se	79.0	+2, +4, or +6
Silicon	Si	28.1	+4
Silver	Ag	107.9	+1
Sodium	Na	23.0	+1
Strontium	Sr	87.6	+2
Sulfur	S	32.1	+6 as sulfate otherwise as -2 or +4
Tantalum	Ta	181.4	+5
Tellurium	Te	127.6	+2, +4, or +6
Tin	Sn	118.7	+2 as stannous in acid plating solutions
			+4 as stannic or stannate in common alkaline plating solutions
Titanium	Ti	47.9	+3 or +4
Tungsten	W	184.0	+6
Vanadium	V	51.0	+3 or +5
Zinc	Zn	65.4	+2

Radicals

Name	Formula and Net Valence*	Name	Formula and Net Valence*
Aluminate	AlO_2^-	Ferrocyanide	$\text{Fe}(\text{CN})_6^{4-}$
Ammonium	NH_4^+	Fluosilicate	SiF_6^{2-}
Arsenite	AsO_3^{3-}	Nitrate	NO_3^-
Arsenate	AsO_4^{3-}	Nitrite	NO_2^-
Borate (ortho)	BO_3^{3-}		
Carbonate	CO_3^{2-}	Permanganate	MnO_4^-
Chlorate	ClO_3^-	Phosphate (ortho)	PO_4^{3-}
Chromate	CrO_4^{2-}	Silicate	SiO_3^{2-}
Cyanide	CN^-	Stannate	SnO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$	Sulfate	SO_4^{2-}
Ferricyanide	$\text{Fe}(\text{CN})_6^{3-}$	Sulfite	SO_3^{2-}

* Note: The number of (—) or (+) signs after the formula is the valence of that radical.

4. Metals

In previous chapters we discussed the make-up of matter in general, concentrating on the two important building units: atoms and molecules. For platers and metal finishers, we may now consider this general subject more specifically in terms of: (1) metals, (2) inorganic acids, bases and salts, and (3) organic compounds i.e. chemical compounds primarily built up around the element carbon. Organic chemistry will not occupy our attention for some time yet. This present chapter will deal with the nature of metals and the following chapter

with the nature of inorganic acids, bases and salts.

As in so many other cases, when we go back in history for the origin of our particular subject, we find that ahead of all others, the Greeks had a name for it; but in ancient days, minerals and ores were grouped with what we now call metals and the word that the Greeks had was therefore based either on "metallan" meaning "to seek after" (as in ore prospecting) or on "metallon" meaning "with another" (i.e. combination, as in ores). From the Greek there evolved the Latin "metallum" and finally came our present word "metal", with its more restricted significance to that type of material whose properties will be described below.

It is somewhat of a blow to our complacency and ego when we consider that although as long ago as about 4000 B.C. almost pure metals were known (copper cylinders of that period exist) we are today, after 6000 years, still unable to specifically define a metal for what it is, being forced to define it in terms of what it can do or what its characteristic properties are. The ancients also classified substances (i.e. metals) on the basis of properties rather than structure, although relating them at the same time to a kind of godfather planet e.g. gold with the Sun and silver with the Moon, the origin perhaps of our present romantic and metaphorical expressions.

Only a small number of metals were then known but their many uses were quite fully appreciated as may be judged from this quotation from the famous Latin writer Pliny: "We are now about to speak of metals (including ores), of real riches, the standards of value of things, objects for which we diligently search within the earth in many ways, for in some places it is dug up for gold, silver, electrum, or copper, elsewhere for riches in gems and pigments, to decorate our fingers and our houses; elsewhere we rashly seek iron more esteemed than gold amidst wars and carnage"—reminding us that in some respects there has been little progress from ancient times.

The early concept of metals was based on a theory that they consisted of various combinations of sulphur and mercury. Figure 2 illustrates how the ancient conception of the primary elements (described in an earlier chapter) ties in with this belief. Today we are still not fully aware of all the details of structure that account for the properties of metals and so, as has been said, we use a description of these properties as a definition and as a basis for attempting to classify all the elements as metals, non-metals, or "transition" (in-between) elements, also called metalloids.

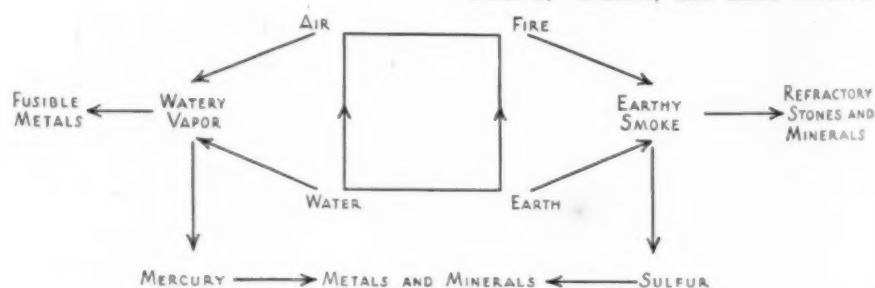


Figure 2. Diagram of ancient conception of metals.

Post Scripts

A Letter from Sam Herrick

Dr. Walter R. Meyer, Editor
METAL FINISHING,
N. Y.

Dear Sir:

Noting the letters in METAL FINISHING and also the articles in Post Scripts, possibly another old-timer can edge in with a few words.

Out here in California, I am located away from the shops and do not see many of the boys in the industry, and when I do, I have to drive 50 miles to see them. But not so long ago I had the pleasure of seeing some of the old timers from the East. First, our old friend, *George Hogaboom*, then *Dr. Blum*, *Oscar Servis* and *Frank Hanlon*. I did not have time to visit long with them, neither could I get Oscar and Frank to stay with us for a few days and enjoy some trips around our wonderful valley.

Some time past there was an article in Post Scripts regarding the large plating tanks back East. Well, I do not like to boast but we have some out here of which we are truly proud. One in particular we keep agitated by running the ferries across. Then we bridged it so as to make it easier crossing. But, out here we go in for other large things.

South of San Jose, we raise lettuce and when Frank and Oscar were here, Frank said, "Look at those immense cabbages, and only just starting to grow". Too bad he could not stay and see what we can grow.

Frank also spoke of the big trees he had seen and then I found out he had only seen a few saplings. Maybe next time he is out here he will stay a few weeks with us and enjoy himself.

Again Frank saw a man fishing and said, "Look at that fish he brought in". And all the man was doing was seeing if his bait was on the hook—just bait.

I noted in this month's issue, an article by Stevie looking for old-timers. Well, I think he owes me a letter.

Now that the convention is over and next year it is to be in Boston, I hope to be there, for this year if I can sell out, I am going to retire and take a trip East in 1941, and hope to see many of my old friends in the plating industry at that time.

Many years I had the pleasure of being one of the founders of the Boston Branch, and trust that the convention next year will be a great success, so that the profession will ever remember Boston as a convention city, and be proud of the work

done by the Boston Branch of the A.E.S.

As I look through the pages of METAL FINISHING, I see names of many of my old friends; some dating back possibly 40 years. I know many have lost track of me but I am still going strong. So sincerest greetings and good wishes to all and trusting to see you in Boston in 1941.

Yours truly,
Sam Herrick.

Henry Disston & Sons of Philadelphia deserve our approbation in considering that a man is not dead when he reaches forty. Many companies could profit by Mr. Disston's viewpoint—"We are interested in a man's skill, ability and character and do not think of him in terms of age . . . we do not tell a man that he is through at forty or fifty; he is just growing ripe at these ages."

Initials of people who never use their full name are often intriguing and especially to one with an insatiable curiosity such as *Leroy Beaver*, the *Lansdale Sage* of *Barrel Burnishing*. Leroy was particularly intrigued by the initials C. B. F. preceding Dr. Young's name and upon inquiry found that they stand for "Clarence Bernard Fehrler" Young.



The photogenic gentlemen shown above are Carl Johnson, (left) of Apothecaries Hall Co., Waterbury, Conn., and G. Stuart Krentel of Seymour Mfg. Co., Seymour, Conn.

We would also like to know the meaning of the "J R" in *Bill Kennedy's* name and the "X" in *Oakite's Dave X. Clarin's* name.

"Catchin' any?", asked the bystander of *Gene Phillips*.

"Caught forty bass out of here yesterday."

"Say, do you know who I am?"

"No," said Gene, "can't say that I do."

"Well, I am the county fish and game warden."

Gene thought a moment, then said, "Say, do you know who I am?"

"No," said the officer.

"Well, I am the biggest liar in Connecticut."

We recently had the pleasure of discussing developments on the annual A. E. S. convention to be held next June in Boston, with *Joe Barron*, General Chairman. Every effort is being made to limit the educational sessions to a maximum of four speakers so that there will be sufficient time for thorough presentation of the papers and extended discussions. Two interesting plant trips have been arranged and a highlight of the convention will be an all-day outing at a large shore hotel with golf course, swimming pool, shore dinner and everything. The ladies have some particularly fine treats in store for them. The Hotel Statler will have room for all and the meeting rooms are air conditioned.

What's this we hear about *Prof. Ed Baker* betting on Cleveland to win the World Series and *Dr. Blum* beating *Stevens' Paul Strausser* at Ping Pong—and that *Frank Hanlon* is really a "nutmegger" at heart hailing from *George Hogaboom's* home town, New Britain, Conn.

Plater: "I'll have to have a raise, sir, there are three other companies after me."

Boss: Is that so? What companies?

Plater: Light, 'phone and water.

There was a man in our town,
The chump thought he was wise,
He swore (it was his policy)
He'd never advertise;
But, one day, he advertised,
And thereby hangs a tale—
His ad was set in six point type
And headed "Sheriff's Sale."

Walter R Meyer

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

New Brass Plating Process

The Electroplating Division of E. I. duPont de Nemours & Co., Inc., Wilmington, Del., have announced the development of a new brass plating process which is said to yield smooth, bright deposits of controlled thickness at rapid rates of deposition. The bath is made from prepared salts furnished by the company, and said to eliminate breaking-in periods.

It is stated to operate without polarization at high anode current densities and a bright, uniform yellow color may be obtained over wide ranges of current densities, which is of particular interest for plating recessed objects.

Addition agents have been added to prevent pitting, to improve lustre and prevent objectionable fumes.

The bath is operated at relatively low temperatures from 105° to 125° F. The solution enables the ready plating of heavy deposits and can be operated to current densities up to 25 amperes per sq. ft., with cathode efficiencies from 50 to 80%. The process employs 70-30 brass anodes which operate without excessive polarization up to 25 amperes per sq. ft.

Literature describing this process can be secured by writing to the Dupont company.

Plating Upon Aluminum

Krome-Alume, Inc., Lockport, N. Y. have announced improvements in their process for plating upon aluminum.

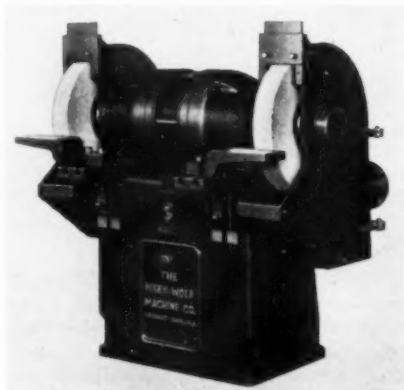
Heretofore it was not possible to plate from cyanide solutions directly upon aluminum. Now, however, the company announces that it is possible to directly deposit zinc and cadmium upon aluminum without an intermediate coat of nickel.

Another development is the direct electroplating of brass upon aluminum to enable excellent bonding for rubber applied to the metal.

It is reported that by the use of brass plating upon aluminum, rubber bonds can be obtained which are double those possible by the use of cement.

New Grinders and Wheel Guards

The Hisey-Wolf Machine Co., Cincinnati, Ohio, have announced the recent development of new 5 and 7½ H. P. pedestal type grinders. These machines are built in 18" and 20" wheel sizes, and the motors are totally enclosed and ventilated through the large pedestal. A continuous circulation of air passes through the motor and out of one motor foot into the pedes-



Grinder with new type wheel guard.

tal, and then into the other motor foot and through the motor again.

These machines can be supplied with new guards which are in accordance with the standards adopted by the American Foundrymen's Association.

It is said to be impossible for a piece of work to jam in between the wheel and the guard. The guard extends far beyond the periphery of the wheel so that all sparks and chips are arrested. The flange on outlet makes an easy connection to the dust collecting system.

Stick Pumice

William R. Rogers, 8 Proctor Street, Salem, Mass., has placed on the market a pumice known as "Stik Pumice", which is composed of coarse grades of American pumice pressed into round sticks of about 7½" long and 2½" in diameter, weighing about 1 pound each.

These sticks, it is reported, are compactly pressed so that the particles of pumice do not crumble or break away when handled by the operator, thus giving a considerably longer life to the pumice, weight for weight, against ordinary lump pumice. As it is used, the particles of clean, white refined pumice cross-section when the stick contacts the revolving grease wheels, resulting in a clean wheel ready for the application of glue.

According to the manufacturer, it is dry, contains no grease, wax, etc., that would have a tendency to "fill" the wheel, and while tightly pressed, wears perfectly under friction with the wheel, causing no tearing of the fibre.

This pumice is packed in handy cases of 100 sticks, about 1 pound each, being easy to store. Special sizes, shapes and grades (coarse to fine) are manufactured.

Controlled Abrasives

The National Metal Abrasive Co., Cleveland, Ohio, have announced the development and sale of controlled abrasives.

In this control, steel shot and grit are said to be given the correct processing in order to produce the best degree of toughness and hardness in relation to their size. It is said that this control results in marked improvements in the use of the shot and the grit, and the customer is able to correlate his abrasive cleaning with the proper selection of abrasive.

Light Weight Respirator

Willson Products, Inc., Reading, Pa., have announced a new light weight respirator.



Light weight respirator.

Professional Directory

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Solution analysis, plant design, process development. Testing of deposits—composition, thickness, porosity, salt spray.

352 Mulberry St. Newark, N. J.

CUT COSTS, BUILD PROFITS

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Tests, Analyses, Advisory Service.

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Electroplating Consultant

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Telephone PEenn. 4-2214

Any plating solution analyzed for \$1.
Reagent solutions for analyzing 25c. pt.

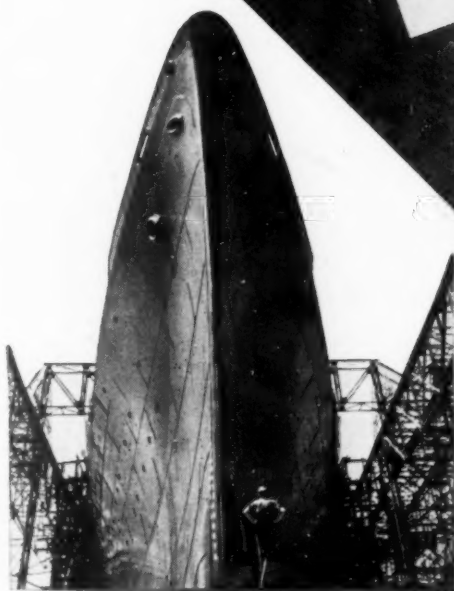
Platers' Laboratory Service

P. O. Box 59, Elizabeth, N. J.

NICKEL... THE VERSATILE ALLOYING ELEMENT



Nickel hides its might under the bustle of business. Unseen, alloyed into hard-working metals, Nickel serves in a thousand ways to increase the abilities and lengthen life of numerous types of equipment. For example, in 1890 slide fasteners were bulky, as shown at right. But 1940 Talon slide fasteners, indicated by arrow, are sleekly streamlined, compactly designed to utilize the properties of Nickel silver. Nickel silver fabricates readily, plates easily, and stoutly resists rust and corrosion.



The maiden voyage of S.S. America will be front-paged, but you probably won't read about the many special Nickel-containing alloys which make this vessel safer and more efficient. Numerous suppliers have specified Nickel alloyed materials for equipment going into the "America" because Nickel improves mechanical properties and adds service life. Revere Copper & Brass, Inc., employed 30% Nickel in 130,000 lbs. of Copper-Nickel condenser tubes installed aboard this new vessel.

... By a dam is another place to learn how much Nickel increases the usefulness of ferrous and non-ferrous metals. Grand Coulee Dam controls a 550' head of water with sixty 8½' spillways. The gates on these sixty huge outlets are sealed safely and tightly with 14 tons of Nickel bronze glands, bushings and other castings. Atlas Brass Foundry, Los Angeles, added 1% Nickel to leaded "G" bronze and exceeded Federal specifications on strength and



elongation. Using the right Nickel alloy may simplify your production or maintenance problems. Your consultation is cordially invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET
NEW YORK, N. Y.

STAINLESS STEEL POLISHING COMPOUNDS

Are Proven Every Day in Every
Kind of a Metal Working Plant



"4-A" Polishing Compounds Are Faster, More Efficient, More Economical for Polishing, Mirror Finishing of All Kinds of Steel, Including Stainless Steel and Other Alloys.

Use it on any kind of a wheel, soft, hard, medium. Results will speak more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem. No obligation, of course.

CEMENT AND THINNER

Instead of glue, use "4-A" Cement and Thinner, a uniform substitute for polishing Wheels, Belts, Buffs, Rolls, etc.

Samples of Compound or Cement sent on request.

HARRISON & COMPANY
HAVERHILL, MASS.

ator called "Willson Bantam Respirator".

This respirator is of the throw-away filter type and is said to be so light in weight and easy to breathe through that it can be worn for long periods of time without causing any noticeable discomfort.

It has an all-rubber face piece which cannot be crushed out of shape.

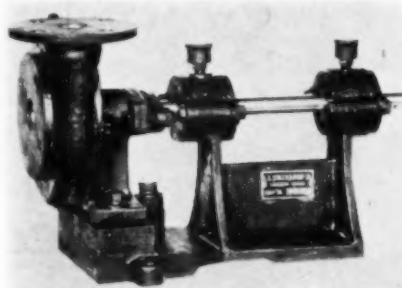
Pumping Plating Solutions

Pumping hot chromic acid plating solutions involves serious corrosion problems if the pump metal is not chosen with the utmost care. This fact has been borne out many times over. At one plating plant, for instance, pumps made of lead had a short life on exposure to the acid plating bath, which contains both chromic acid and chromate salts and is maintained at a temperature as high as 208 deg. F. The lead pumps lasted but 3 to 4 months.

The E. G. Schleyer Pump Company of Anderson, Indiana, tackled this problem several years ago and, upon their recommendation, pumps cast of Hastelloy alloy

C, a nickel-base, corrosion-resistant alloy, were installed in the continuous plating service in August, 1937.

In April, 1938, eight months after the nickel-alloy pumps were placed in service, they were inspected and found to be in good condition. Again, in September, 1938, the pumps were inspected and found still to be standing up very well. The studs, which were originally of another metal,



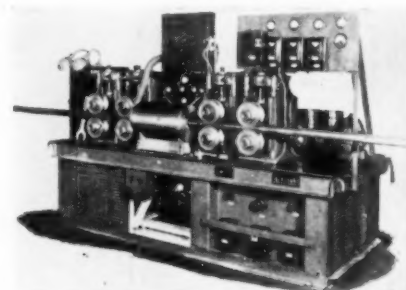
Assembled pump used for circulating chromic acid plating solution.

required replacement at this time, and new studs were accordingly machined from Hastelloy C bars. The pumps were restudded and placed back in service. When last heard from these pumps had been on duty for a total of 33 months—almost 3 years, with total repairs averaging less than 12 per cent per year. Pumps made of other materials have never been worth repairing after 18 months' use. This remarkable achievement for a metal is considered to be a record in a solution so well-known for causing corrosion problems.

Electric Detector for Tubes

Sperry Products, Inc., 1505 Willow Ave., Hoboken, N. J., have announced their new Tube Detector Equipment for production inspection in mills. This Detector can be used for testing tubes of either magnetic or non-magnetic material. In the case of the former, an essential feature is the elimination of the magnetic effect of the material, permitting the complete penetration of the A. C. testing current. The detection of a defect results from the displacement of the A.C. current.

The Electric Testing Equipment is supplied by Sperry, and the handling equipment is normally supplied by the customer.



Electric detector for tubes.

In operation, tubes are fed automatically at a constant speed through the detection coils. The presence of a defect operates a signal lamp and at the same time immediately stops the tube feed. This equipment operates independently of the tube manufacturing process, and thus permits testing of tubes of different size and gauge as a separate operation. The testing equipment is easily handled by one operator.

Typical defects detected are: section of inner wall enlarged, sliver type external surface defect, discontinuous defective wells and other imperfections in tubes.

Electroplating Colalloy, Aluminum and Its Alloys

Joseph Steel, Director of Research, of the Colonial Alloys Company of Philadelphia, Pennsylvania, Chemicals Division, announces a low cost, easy method of commercially electroplating Colalloy, aluminum and aluminum alloys. This applies to all of the known alloys.

The process consists of a two to four minute dip in a solution known as "Pre-

plate", which is furnished by the company. There is no electrolytic preparation necessary and the chemical solution is used at room temperature. After this dip, the product is ready for the regular plating bath. No special tanks or equipment are necessary. The size of the work is not a limiting factor.

Heretofore, it has been well known that aluminum base metals were difficult to electroplate due to the stubborn and instant forming oxide on the surface of the metal. Various methods, from chemically etching the base metal, to building up the oxide, have been in use but have either lacked efficiency, required costly equipment or took too much time to be commercially feasible.

Using the "Pre-plate" method for electroplating aluminum and its alloys, there is no difficulty with the oxide coat, the bond is efficient and strong, there is no special equipment needed and the preparation time is but from two to four minutes.

"Pre-plate" creates an excellent dense bonding base for the metal that is to be plated on it. It lends itself to direct plating of such metals as gold, silver, copper, cadmium, and the other alkaline plating baths on the aluminum base metals. Nickel, chromium and other metals are plated over copper, after preplating.

Preplating and its subsequent plating gives to the aluminum base metals increased corrosion and abrasion resistance, as well as decorative value. Many cases where it was necessary to use an oxide coat for both protective and decorative purposes, now lend themselves to this method of electroplating.

The aluminum base metals, heretofore restricted in use because of inadequate protective and decorative value, now can broaden their field. Such items as reflectors, trim parts, hardware, mouldings, architectural forms, novelty ware, jewelry, kitchen ware, appliances, aviation equipment, automotive parts, and many other products too numerous to mention, can enjoy this long felt need.

Cost Comparison Test Kit for Pre-Finished Metals

American Nickeloid Co., Peru, Ill., have placed on the market a new cost comparison test kit for Pre-Finished metals, which consists of three items:

1. Actual working samples of the metal or metals recommended by their engineering department as being best suited to the customer's requirements, bearing in mind both cost considerations, quality and adaptability to the type of fabrication involved in making the part.
2. Portfolio of suggestions and instructions for use of factory foreman and superintendent in securing the best results from pre-finished metals in test work.
3. Cost comparison portfolio, which gives reasons for choosing the American Bonded Pre-Finished metal recommended and including multiple copies of a com-

CUT!



When a Hollywood director sees that a scene is being poorly handled he calls, "Cut!" This stops the cameras and prevents the waste of time, talent and film.

Many metal finishers are finding an easy way to cut excess costs in cleaning ferrous metals prior to bright plating. They use a Wyandotte Product that removes smut and fabricating compounds quickly and thoroughly.

One large manufacturer, plating bright nickel direct on steel, reports a 60% cut in cleaning cost. Your Wyandotte Representative can help you solve your metal cleaning problems. Write us.

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THE J.B. FORD SALES CO. SERVICE REPRESENTATIVES IN 88 CITIES
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KREIDER Centrifugal DRYER

For Drying All Types of Plated Work and Lacquering Small Parts

Speeds Up Production . . . Cuts Costs . . . Improves Quality



The new Kreider Centrifugal Dryer reflects our many years' experience in this field. It is the result of our engineers effort to produce the best. Although unusually simple in design and easily operated by one man, the Kreider Dryer speeds up production and improves the quality of the work. An auxiliary steam heating unit can be supplied as standard equipment when drying parts which have a tendency to retain water and additional steam is needed in the drying operation. Reversing drum switch is supplied on all dryers.

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MUTUAL CHEMICAL CO. OF AMERICA

270 MADISON AVE. NEW YORK
PLANTS AT BALTIMORE AND JERSEY CITY MINES IN NEW CALEDONIA

parative cost sheet tabulation and also a summary.

This kit is said to be useful for firms plating and polishing their metal parts after fabrication. It is believed, however, that companies using plastics, leather, glass, etc., would also find it useful.

Quick Cleaning Filter Press

A new filter press has been developed by T. Shriver & Co., Harrison, N. J. for the purpose of reducing the amount of time and labor required to remove the filter cake after filtration has ceased. Manual cleaning of the filter press is ordinarily resorted to and as this work takes up a large share of the filtration cycle, considerable saving in time can be effected by this new method of cleaning out the filter press.

In general this quick cleaning or sluicing filter is not unlike the usual type of plate and frame pressure filter. However, special frames have been designed with ribs which support the filter cloth so that pressure can be applied behind them. The operation of the sluicing filter for filtration is in the usual manner. When the filter chambers are full of solids, filtration is stopped and the remaining liquid drained off. Water from 30-50 lbs. pressure is then introduced and the drain cocks in the frames opened. This causes a sudden flow of water backwards through the filter cloth which loosens the cake and washes it out as a thin slurry through the drain cocks. Short surges of sluicing water filling each chamber and then released by opening each cock in turn effect a quick removal of the cake. When sluicing is completed, the next filtration cycle may be started at once. Thus a long series of runs can be made without opening the filter for cleaning. The time required for sluicing the filter is much shorter than that required to open and manually clean a filter of the same size. Since sluicing involves only the manipulation of a few valves, one man can clean the largest filter with ease. It has been found by test that:

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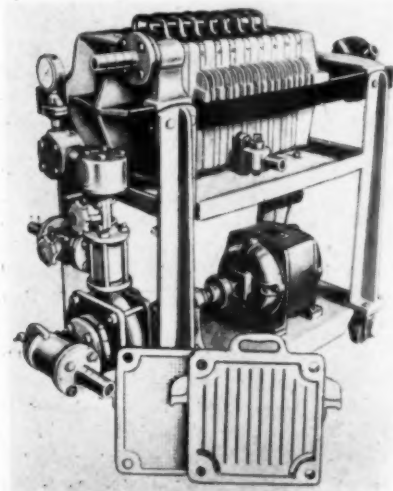
To all responsible manufacturers, samples of any or all American Bonded Metals. Consultation service on design and recommendations given without obligation.

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AMERICAN NICKELOID COMPANY

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Quick cleaning filter press.

1—The filtrate yield using the sluicing method is as much as 30% greater than that from filtration involving manual cleaning.

2—The total time required for a series of sluicings is materially less than for opening and manually cleaning a filter press.

3—As the filter cake is in the form of a slurry when removed from the filter press, it can be readily disposed of without manual labor.

The unit illustrated here is a 12" Closed Delivery Type Press having 8 chambers and equipped with a large outlet cock for sluicing purposes. On larger filtering units individual outlet cocks are installed on each frame. These can be manipulated to concentrate the sluicing water in any one chamber so as to assure more complete discharge of the slurry.

New Variable Speed Polishing and Buffing Lathe

A new addition to the Hammond of Kalamazoo line of Polishing and Buffing Lathes is the model "VRO" Variable Speed Machine as shown.

It has an "overhanging" spindle, the front section overhanging 12½" from lower front of base and is especially desirable on large bulky pieces.



Variable speed polishing and buffing lathe.

Speed change of 1500 to 3000 RPM can be obtained by merely turning the hand wheel and which is accessible from the front of the machine. The indicator at the side of the hand wheel indicates the speed at which the lathe is running.

For particulars write Hammond Machinery Builders, Inc., 1601 Douglas Ave., Kalamazoo, Michigan.

Huge Vulcanizer

Anticipating defense requirements by several months, The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., recently placed in service in the Passaic plant, what may easily be the largest vulcanizer in the country.

It is so large—15 ft. in diameter—that, when open, it looks like a section of a vehicular tunnel. A large van or bus could drive into it with plenty of clearance. It will accommodate practically any piece of equipment that can be shipped by rail.

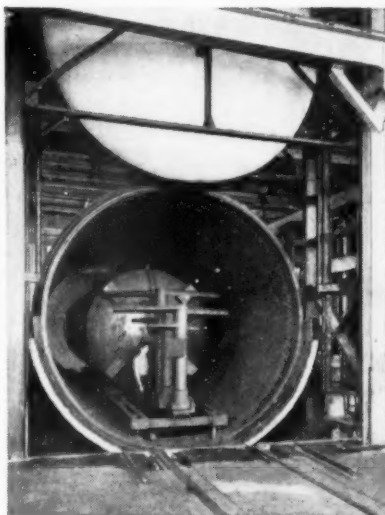
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Harshaw anodes and chemicals are produced by tried and proven methods of manufacture—methods developed through thirty years research in cooperation with customers . . . Every phase of the plating operation has been considered in this development of better anodes and chemicals . . . Depend on Harshaw Quality for continuous production and best results.

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Fifteen-foot vulcanizer.

One of the important defense production uses will be for the vulcanizing of huge rubber-lined tanks and other chemical or allied process equipment which needs protection from corrosive liquids or from contamination, metal stains or surface discoloration to the processed materials.

Another defense industry which will be served by this mammoth vulcanizer is ship building. Huge propellers, sea water-handling pumps and piping and other merchant and war vessel equipment need the protection of rubber linings or coatings.

The size of this vulcanizer is indicated by the illustration showing a workman and several large pieces which have been vulcanized and are ready for removal.

+ +

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"Cleaner Surfaces for Better Finishes"

**THE COWLES DETERGENT CO.'s
QUALITY PLEDGE TO THE METAL CLEANING FIELD**

★ This slogan is destined to become a by-word in the metal cleaning industry.

You are, of course, continually alert to the most advanced developments in more efficient and concentrated cleaners. Hence you will want to know about the great Cowles line of TWELVE different outstanding *technically anhydrous* cleaners.

Call a Cowles Service Man—let him tell you about the Cowles line of ANHYDROUS Cleaners and demonstrate the superiority of Cowles Metal Cleaners ...or help you solve your cleaning problems.

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7016 EUCLID AVENUE CLEVELAND, OHIO**

"CLEANER SURFACES FOR BETTER FINISHES"



When BEST it's FELT

Companies that make their product look worth the difference to the buyer use Paramount Brand Felt Polishing Wheels to polish the base metal, knowing that to have the best finish, you must start right, which means, Paramount Felt Polishing Wheels.

Ask Your Supplies Salesman
for PARAMOUNT BRAND

BACON FELT CO. WINCHESTER
MASS. ESTABLISHED
1824

Manufacturers' Literature

Acid-Proof Brick. Harbison-Walker Refractories Co., 1800 Farmers Bank Building, Pittsburgh, Pa., have issued a 6-page folder describing and illustrating the company's various sizes of acid-proof brick and tile. These materials are said to be dense, vitreous, non-absorbent and strongly resistant to the action of solvents. They are recommended for service in floors and pickling tanks.

Aluminum Pistons. Aluminum Co. of America, Pittsburgh, Pa., have issued a 38-page booklet describing aluminum pistons and aluminum cylinder heads. The proper construction of pistons is described and illustrated. The types of cylinders for specific uses are outlined and these are illustrated by photographs and drawings. Piston materials and piston finishes are also discussed. A chapter on aluminum cylinder heads is included. Booklet can be secured free of charge by writing to the Aluminum Co.

Belting. B. F. Goodrich Co., Akron, Ohio, have just published a new 170-page "V-Belt Data Book", which is available on request. This book gives alphabetical listings of belt requirements for all types of machines. Manufacturers part numbers are given and various group listings of belt sizes and dimensions are also given.

Cleaner. Magnus Chemical Co., Inc., Garwood, N. J., have just issued a new descriptive illustrated folder on its product, "Magnus Cement Cleaner". This material is a concentrated powder from which a liquid floor cleaner is made by stirring into water. The folder completely describes the product and shows applications of it in industrial plants.

Magnetic Analyzer. The General Electric Co., Schenectady, N. Y., have recently issued a bulletin describing the General Electric magnetic analyzer. This device is for differentiating between magnetic and non-magnetic forms of iron oxide and is said to have many advantages over chemical methods of analysis.

Rubber Coated Products. Automotive Rubber, Inc., 8601 Epworth Blvd., Detroit, Mich., have issued a 4-page illustrated folder and a bulletin describing and illustrating various rubber coated products as coated by the company. These include plating racks, dipping equipment, large tanks, anode savers, washing machine activators, fans, etc.

New Books

The Zinc Industry. By Ernest V. Gent. Published by the American Zinc Institute, Inc., New York City. Size 6 1/4" x 8 1/4"; 30 pages. Copies may be obtained free

of charge upon written request to the above institute at 60 E. 42nd St., New York.

This revised edition of the book which appeared in 1932, discusses zinc from the mine to the market. The early history of zinc is given followed by data on consumption and illustrations of uses for zinc in industry. Marketing information is also given.

The Working, Heat-Treating and Welding of Steel. Second edition. By H. L. Campbell. John Wiley & Sons, Inc., New York City. Size 6 1/4" x 9 1/4"; 225 pages. Price \$2.25.

The purpose of this textbook is to present in a concise way the principles and the practice relating to the working, heat treating, and welding of steel. In the first chapter, the reader is introduced to the steel-making processes; then follow discussions on methods for testing steel, the chemical composition of steel, and the classification of steel. The characteristics of the physical constituents in steel are described, as well as the effects of temperature changes and mechanical working upon the grain size and the resulting properties of steel. The processes for working, heat treating and welding steel receive considerable attention in the text. Because of the ever-increasing uses of steel products, and the tremendous waste due to corrosion, methods for protecting steel from atmospheric corrosion are revised in the last chapter. A series of laboratory assignments is appended to the text to serve as a guide for the laboratory instruction which is usually given as part of this course of study. Many of the operations used in industrial shop practice are included in the laboratory assignments.

Arc Welding. Published by Hobart Bros. Co., Box EW-65, Troy, Ohio. Size 5 1/2" x 8"; 218 pages. Price 50c.

This little manual presents practical lessons in arc welding for the beginner in this field. The first section deals with general information; the second with practical welding lessons; the third on carbon arc welding followed by discussions of the welding of various ferrous and non-ferrous metals and other features of welding, such as flame cutting.

Illustrated with photographs and drawings.

Text-Book of Physical Chemistry. By Dr. Samuel Glasstone. Published by D. Van Nostrand Co., Inc., New York City. Size 6" x 9"; 1286 pages. Price \$10.00.

The purpose of the author in writing this book is to bridge the gap between the elementary texts of physical chemistry and the few advanced treatises available, and in the reviewer's opinion, he has succeeded admirably in doing this. The author has consistently endeavored to give the modern point of view, and the many literature references enables the reader to seek more comprehensive sources of information on any one subject, if such is the desire.

Mathematical treatment is rather simple

"UNICHROME" RACK COATING-W "FOUR TO ONE BETTER than the best material previously used!"



This statement made by a recent "Unichrome" Rack Coating-W user is typical of the enthusiastic praise earned by "Unichrome" Rack Coating-W wherever used.

We are sure you will agree that this new rack-coating material is indeed remarkable when you consider its unequalled combination of advantages:

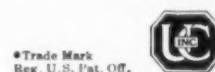
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Annual Educational Session and Banquet Detroit Branch AMERICAN ELECTROPLATERS' SOCIETY Hotel Statler, Saturday, Dec. 7, 1940

Speakers

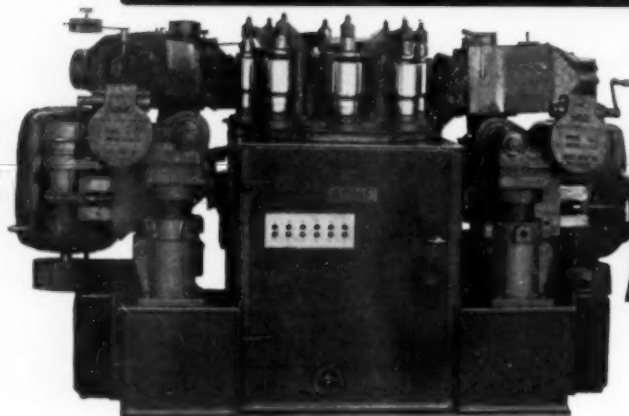
Dr. C. F. Kettering—General Motors Research Laboratories
Dr. F. A. Rohrman—Michigan College of Mining & Technology
Mr. F. F. Oplinger—E. I. duPont de Nemours & Co.

Reservation for table of ten may be had by sending check in amount \$30 to Chas. R. Beaubien, 13919 Robson, Detroit.

Everybody Welcome

The Event of the Season

WHY NOT DO YOUR *Polishing and Buffing* FASTER AND CHEAPER?



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THREE
WHEEL
ROTARY
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**SEND
SAMPLE
for
FREE
Production
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Where speed is a factor in polishing and buffing, or where the problem is one of reducing production costs, Acme Automatics have a definite place.

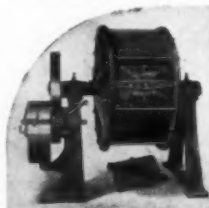
Consider, for example, the Three-wheel Rotary Automatic, illustrated above—a heavy duty machine designed principally for cylindrical work. It does its job with a rapidity that is almost unbelievable. And, at the same time, it produces a better finish than can be obtained by any other method.

Bring your polishing or buffing problem to Acme! It may surprise you to find how easily one of the many types of Acme Automatics can be adapted to your particular needs, speeding up production and materially reducing costs.

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Prepare for a fine plate first by burnishing small, metal parts. After plating, burnish again. That rolls down the surface, closes pores, increases resistance to corrosion. Pressure does the job. Therein lies the advantage of Abbott high, narrow barrels which take a charge of several hundred pounds of steel burnishing materials. This mobile weight, confined within an upright area, develops maximum pressure on the work. Questions gladly answered. Orders promptly filled.



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and should be understandable to those with a fair knowledge of calculus. Subject matter throughout the entire range of physical chemistry is discussed, and this book should find extensive use by the student of chemistry and also to a large measure, by graduates of chemistry or physical sciences, who wish to review various phases of physical chemistry according to modern viewpoint.

Drawings and photographs are used extensively to illustrate the text.

The author appears to have given proper proportionate amount of discussion to the various subjects without having any particular branch of physical chemistry predominantly discussed.

Directory of New England Manufacturers. 1941 Edition. Published by George D. Hall, Inc., 30 Kilby St., Boston, Mass. Size 11" x 8"; 765 pages. Price \$20.00.

This book is published with the editorial cooperation of the New England Council, and contains a comprehensive survey of manufacturers of New England.

The book is well indexed with alphabetical listings of the names of the companies, geographical listings and products listings. Thus from the book one is able to determine the manufacturers of any one town, county or state and by referring to the alphabetical listing, can determine the capital rating of the company, the number of employees and the products made. Various community statistical information is also given.

Technical Literature

Influence of Cyclic Stress on Corrosion Pitting of Steels in Fresh Water, and Influence of Stress Corrosion on Fatigue Limits. By D. J. McAdam, Jr. and G. W. Geil. Research Paper RP 1307. U. S. Dept. of Commerce, National Bureau of Standards, Washington, D. C.

Associations and Societies

American Electroplaters' Society

Plan to Attend the June Convention To Be Held in Historical Boston

Bridgeport Branch

At the October 25th meeting, Derick S. Hartshorn, Jr., technical director of the Enthone Company, New Haven, Conn., presented a talk on "Surface Tension Depressants". In the talk, an outline of the theory of surface tension, methods for measuring the same and specific uses of wetting agents, were given.

Clarence C. Helmle of the General Electric Company was technical chairman.

Detroit Branch

Annual Meeting

The Branch's annual meeting will be held Saturday, December 7th, with the

educational session starting at 2 P.M.

Three outstanding men of science are announced as speakers at the educational session. These speakers are as follows:

Dr. C. F. Kettering, General Research Laboratories, General Motors Corp. Subject not yet announced.

Dr. F. A. Rohrman, Michigan College of Mining and Technology. "Vagaries of Corrosion Testing".

F. F. Oplinger, E. I. duPont de Nemours & Company. "Copper Plating".

The banquet will be held in the evening with the usual excellent entertainment and dance orchestra.

Hartford Branch

The Hartford Branch of the American Electroplaters' Society held their regular monthly meeting October 20th at the General Research Laboratory of the Underwood Elliott Fisher Company, Hartford, Conn. Several guests and members from branches in Waterbury, New Haven, and Bridgeport attended and approximately 150 were present.

Those attending were conducted through the various departments including special laboratories devoted exclusively to sound analysis, life testing of business machines, heat treatment of metals, organic finishing and electroplating.

Following the tour of the laboratories, members were greeted by *Ellsworth Candee*, first vice-president of the National Society, and *W. J. R. Kennedy*, executive secretary of the National Society.



Attendants at Hartford Branch's round-table discussion.

The program was concluded by a round-table discussion of electroplating and finishing problems.

The discussion program was patterned after the radio version of "Information Please" and members of the audience were invited to present their problems to the committee of experts made up of: *Henry Smith*, R. Wallace & Sons, Wallingford; *Ralph Colter*, Chromium Corporation, Waterbury; *J. H. Donahue*, The Abbott Ball Company, Hartford, and *Joseph G. Sterling*, General Electric Company, Bridgeport. *Jack Costigan* of Springfield was chairman and moderator of the session.

Lancaster Branch

A. P. Munning, vice-president, Munning & Munning, Inc., Newark, N. J., addressed the branch on October 11, the subject of his talk being "Polishing".

At the November meeting, to be held Friday, November 8th, at the Y.M.C.A., Harrisburg, Pa. *Dr. R. W. Mitchell* of the Magnus Chemical Company, Garwood, N. J., will be the speaker. Messrs. *Harold Kilheffer*, *Karl Nuss* and *Charles Snyder*, are the committee in charge. *R. E. Shay* is publicity chairman.

Los Angeles Branch

The first Fall meeting was held at the Rosslyn Hotel and was designated as "Bring a Prospective Member Night", and attracted approximately 40 members and guests.

Business, accumulated during the summer, was conducted and various letters and communications were read.

Marcus D. Rynkofs reported that a night class in chemistry will be held as well as an advance class. Instructress will be *Florence M. Shelley*.

Alfred Pritchard of the Rochester, N. Y. chapter was transferred to the Los An-

geles chapter. Mr. Pritchard is now employed with the Expert Lamp Company.

Philadelphia Branch

Annual Meeting

The annual educational session of the branch will be held Saturday, November 23rd. The meeting place will be the Broadwood Hotel, corner Broad and Wood Streets. The educational session will start at 2:30 P.M., and *Dr. Edward P. Sanigar*, chairman of the educational committee has announced the following speakers and subjects:

1. *Dr. Samuel Glasstone*, Princeton University, author and lecturer, formerly of England, will discuss "Overvoltage and Its Importance in Electrodeposition".
2. *Dr. Wm. Blum*, National Bureau of Standards, Washington, D. C., will give a talk entitled "What Pure Metals Can Be Deposited from Aqueous Solutions".
3. *Charles C. Conley*, 3rd vice-presi-

GOING TO DO YOUR OWN CHROMIUM PLATING?

Manufacturers contemplating the establishment of their own plating plants should familiarize themselves with Metals Protection Corporation patents and the licensing arrangement under which these are available.

A pioneer in the chromium plating field, Metals Protection developed and owns exclusively the "reverse current" patent so necessary to successful hard chrome plating. The patent numbers and description of the patents owned by this corporation are as follows:

- 1,465,173—"Method of Electrodepositing Cobalt and Chromium."
- 1,545,196—"Chromium Plating". (Pierce-Humphries Plating Bath & Process.)
- 1,614,303—"Process of Producing Corrosion-Resisting Coating on Iron and Steel and Products Thereof." (Multiple Coatings, such as Chromium on Copper on Cadmium, etc.)
- 1,615,585—"Process of Producing Corrosion-Resisting Coatings on Iron and Steel and Product." (Multiple Coatings, such as Chromium on Copper, Brass, Cadmium, Zinc, Nickel, etc.)
- 1,645,927—"Chromium Plating". (Reversal of Current Process for Hard Plating.)
- 1,651,278—"Process of Producing Corrosion-Resisting Coating on Iron and Steel and Products." (Multiple Coatings, such as Chromium on Copper, etc.)
- 1,774,269—"Plating Process." (Anodic Treatment of Iron and Steel Prior to Plating.)
- 1,836,598—"Process of Chromium Plating." (Satin Finish Plating.)
- 1,857,547—"Chromium Plating." (Control of Bath with Barium Chromate or its equivalent.)
- 1,857,548—"Technically Pure CrO₃."
- 1,963,363—"Plating Fixture." (Improved Plating Rack Especially Adapted to Hard Plating.)

Write us for complete details of these patents and our special engineering and analysis services.

METALS PROTECTION CORPORATION

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dent of the A.E.S., will have as his subject, "Control in the Plating Room".

4. *George B. Hogaboom*, engineer, Hanson-Van Winkle-Munning Company, Matawan, N. J., will discuss "The Electroplater's Part in the National Defense Program". Mr. Hogaboom is particularly qualified to discuss this subject in view of his past war experience and present contacts. He is a member of the Army Ordnance Association.

Galvanizers' Committee

The Galvanizers' Committee is to hold its Fall meeting at the Lord Baltimore Hotel, Baltimore, Md., on November 14th and 15th. This will be the 8th meeting of the Committee which is sponsored by the American Zinc Institute.

On the first day of the meeting the Bethlehem Steel Company has scheduled a luncheon and plant inspection trip for committee members. Special papers are to be presented at the technical sessions on the second day and in addition there will be the usual round-table discussions of shop problems.

J. L. Schueler of the Continental Steel Corporation is the chairman of the Governing Board and the Program Committee consists of *N. E. Cook* (chairman), Wheeling Steel Corporation; *R. H. Dibble*, Carnegie-Illinois Steel Corporation, and *D. A. Russell*, Youngstown Sheet and Tube Company.

Personals

Harold Faint Joins Hammond Machinery Builders, Inc.

Hammond Machinery Builders, Inc., Kalamazoo, Mich., have announced that *Harold W. Faint* has joined the organization, which has taken over the line of semi-automatic polishing and buffing machines of the Continental Roll and Steel Foundry Co. Mr. Faint has had years of experience in technical and practical aspects of plating, polishing and finishing.

McGean Chemical Co., Cleveland, Ohio, have announced the appointment of *Tom R. Gill* to their sales organization. Mr. Gill will work out of the company's main office at Cleveland. He is well known in the plating industry and was formerly associated with the Udylyte Corp. and with LaSalco, Inc.

F. L. Curtis, treasurer of Raybestos-Manhattan, Inc., and general manager of the Manhattan Rubber Mfg. Division, Passaic, N. J., was elected a director of the Rubber Manufacturers' Association at the annual meeting on October 17 in New York.

D. E. Williard has become sales manager of the Industrial Division of Detroit Rex Products Company, Detroit, Mich.

Joseph W. Cluff, president of Frederic B. Stevens, Inc., Detroit, and Mrs. Cluff, were recent visitors to Southern California, flying to Los Angeles by stratoliner. The 10-day visit was spent in Los Angeles, San Diego and San Francisco. Mr. Cluff's only divergence from the strictly "pleasure trip" nature of his visit was to call at the offices of the foundry division of the company.

Industrial Lubricants Company, Inc., Detroit, Mich., makers of polishing wheels, cement and drawing compounds, have announced the appointment of *Harry C. Brainard* to the company's sales and service department.

Mr. Brainard, one of the pioneers in the development of polishing techniques for use with stainless steel, comes from the polishing-grain cement department of the Park Chemical Co., Detroit, where he has serviced major accounts in the territory for the past six years.

Gilbert L. Wolfe has been appointed representative of the American Nickeloid Company, of Peru, Illinois, to have charge of their Schenectady, New York, office and to cover central New York state for their pre-finished metals.



MODERN GRAVURE

ALL-SARCO

SARCO STEAM TRAP

Five lead-lined copper plating baths are a vital factor in the successful operation of a new and thoroughly modern gravure plant in New Jersey.

Lead-protected tubing extends from the tank bulbs to the floor below, where there are five Sarco TR-22-R Temperature Controls. Sarco Thermostatic Steam Traps drip the steam risers, shown above. Sarco is also used in this plant's new up-to-date boiler room.

This is one of the many cases where heat without waste and temperature without damaging fluctuations were insured by Sarco. Ask for Cat. Nos. 48 & 52.

SARCO SAVES STEAM

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183 Madison Avenue, New York, N. Y.
SARCO CANADA LTD. FEDERAL BLDG. TORONTO, ONT.

ACE SHAKER



For Separating Sawdust, Balls, Etc. From Your Work. Does a Tedious 3 Minute Hand Job in 20 Secs. and Does It Better.

Uses Standard 18" Sieve. Produces a Rotary Oscillating Movement—No Dead Spots. No Sawdust or Water Can Get Into Moving Parts. Write:

ACE ENGINEERING & MACHINE CO.
3644 N. Lawrence St. Philadelphia, Pa.

Mr. Wolfe has had considerable experience in production and sales work in the metal industry, having formerly been employed by Revere Copper and Brass Company at Rome, N. Y., and at New Bedford, Mass. He will present to manufacturers in that area the American Nickeloid line of pre-finished metals—finishes of chromium, nickel, copper or brass electro-bonded to base metals of steel, zinc, brass, copper, tin, or aluminum. Their products are available in sheets, strips, and in long continuous coils, as well as in corrugated and striped patterns.

Michigan Alkali Co. Fetes Old Employees on 50th Anniversary

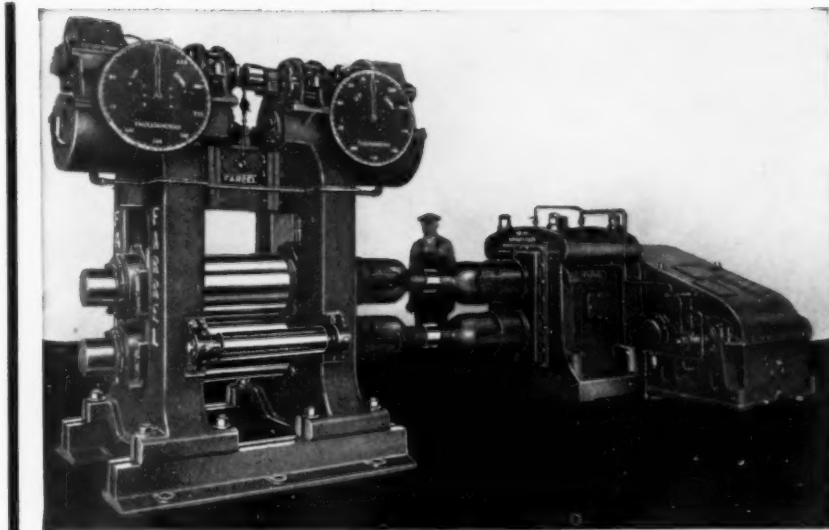
Michigan Alkali Co., Wyandotte, Mich., one of the nation's largest chemical industries, celebrated its golden jubilee October 17, with a banquet in honor of 567 veteran employees.

As a token of appreciation for their long service with the company, the honor guests were presented with gold watches. Awards were made by company officials, including Emory L. Ford, president and J. B. Ford, Jr., vice-president. The banquet also was attended by J. B. Ford, Sr., retired president and grandson of the late Capt. J. B. Ford, founder of the company 50 years ago.

Fifty-two of the veteran employees receiving the token awards have been with the Michigan Alkali for more than 40 years.

All of the 567 honor guests receiving watches had been with Michigan Alkali for a quarter century or longer. Many of them recalled the budding days of the company and the intense interest of old Captain Ford in its successful foundation.

The J. B. Ford Company, which grew out of the Michigan Alkali Company, manufactures a wide range of cleaning products from basic chemicals largely supplied by Michigan Alkali. Wyandotte cleaners and cleansers are known throughout the laundry, dairy, bottle washing and metal cleaning fields, in addition to many other fields where their products are used in the cleaning of buildings, hospitals, institutions, hotels and other similar institutions.



NEW FARREL ROLLING MILL

for HEAVY DUTY and HIGH PRECISION

This 20" x 32" two-high cold strip mill is designed for high precision rolling of aluminum, aluminum alloys, duralumin and other non-ferrous metals. It is built with Farrel ruggedness to take heavy passes at high speed and to do it continuously.

The rolls of this mill are forged tool steel, heat-treated and hardened. They are carried in precision type, flood-lubricated sleeve bearings and connected to the pinion stand with universal spindles. The mill housings are of cast steel of very heavy section.

The double motor screwdow, built into the housings, provides ease of manipulation and facilitates setting the rolls with extreme accuracy. Adjustment can be made against the metal while the mill is in operation. A magnetic clutch permits the sepa-

rate operation of each screw or the synchronization of both, as required. The screwdow gearing is fully enclosed and is lubricated by a continuous circulating system.

The drive is a combined double reduction gear unit and pinion stand with Farrel-Sykes continuous tooth herringbone gears and mill pinions mounted in anti-friction roller bearings. A built-in oil pump provides spray lubrication of the gear teeth and flood lubrication of the bearings.

This mill is typical of the modern design features built into Farrel rolling mills, which permit high speed operation, increase output, improve quality and reduce production costs. Our engineers will be glad to explain the various features available and their applicability to specific conditions.

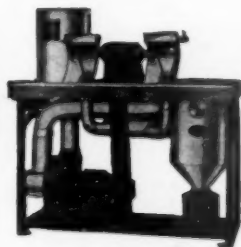


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George B. Hogaboom, electroplating engineer, and Irving A. Gemmel, New York sales representative of the Hanson-Van Winkle-Munning Company, Matawan, N. J., attended the meeting of the National Stereotypers' and Electroplaters' Association, Sept. 18-20, at the Hotel Roosevelt. Mr. Hogaboom addressed one of the sessions of this convention on the subject of nickel plating.

Harry A. Johnson, Magnuson Products Corporation, Brooklyn, N. Y., formerly in charge of Michigan and Ohio territory for this company, has been transferred to the Central and Eastern New York territory.



Harry A. Johnson

C. C. Hermann has been appointed Chief Engineer of the Claude B. Schneible Co., Chicago, designers and manufacturers of dust collection equipment, dewatering equipment, sludge pumps and vent hoods.

Mr. Hermann was in charge of the company's Philadelphia office as sales engineer since 1937. Previous to that he was connected with the Engineering Department of Deere & Co. at Moline, Ill., for many years; and later was plant engi-

neer of John Deere Tractor Co. of Waterloo, Iowa.

Mr. Hermann is a licensed mechanical engineer, a member of the U.C.C. of E., the A.F.A. and other engineering societies and groups, and is well known to the engineering profession having been a liberal contributor to engineering journals and to the trade press during the past twenty years.

Business Items

Pennsylvania Salt Manufacturing Co., Widener Bldg., Philadelphia, Pa., have announced the election of the following officers:

Leonard T. Beale, president

Y. F. Hardcastle, vice-president

N. Emory Bartlett, vice-president

L. A. Smith, vice-president and treasurer
Warner R. Over, secretary and assistant treasurer

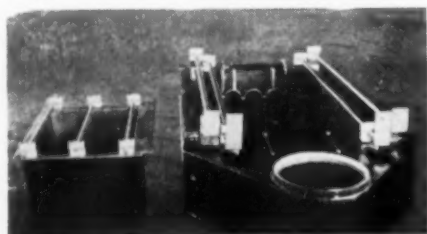
The company is engaged in the manufacture of heavy chemicals, metal cleaners, cements, etc.

Announcement has just been made by the Roots-Connersville Blower Corp. of Connersville, Ind., that J. T. Sutliff is now in charge of the company's Chicago office which is located at 122 South Michigan Avenue.

Mr. Sutliff, who succeeds the late Wm. Townsend, has been connected with Roots-Connersville for many years, and prior to going to Chicago in 1935 he was located at the factory.

E. A. Coons, also a graduate engineer, has been placed in the Chicago office to assist Mr. Sutliff.

Spraying Systems Co., 4019 W. Lake St., Chicago, Ill., announce the appointment of two new agents in the East. F. R. Magill, 1807 First National Bank Bldg., Pittsburgh, Pa., will represent this company throughout western Pennsylvania and in the neighboring steel districts of Ohio and West Virginia. Also, the Manufacturers' Supply Co., 1201 C St., N.E., Washington, D. C.



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Cannon Electrical Development Co. is building a new one- and two-story stucco house factory at 3200 Artesia St., Los Angeles, within a block of its existing plant. Building and equipment are estimated to cost \$100,000. The new plant will have double the floor area of the one at 420 West Avenue 23.

Cannon Electrical & Mfg. Co. began moving into its new plant, 3200 Artesia St., Los Angeles, on October 10. Much of the plating equipment from the old factory at 420 West Avenue 23 has already been moved into the large new plating room of the \$100,000 new plant, where degreasers, paint and lacquer spray equipment, sandblast machines and barrel plating and cadmium tanks have been added to the hold-over equipment.

Meysers Aircraft Company Tecumseh, Mich., plans additions to double present capacity in parts production and assembling divisions, providing for output of about 20 complete training planes per month. Cost over \$75,000 with equipment. The following departments are operated: rolling, stamping, spinning, brazing, welding, cadmium plating, sand blasting, grinding, polishing, buffing, lacquering and painting. The principal base metals used are: steel, copper, bronze and aluminum.

The Bogue Electric Co. have expanded their facilities at 80 Glover Avenue, Paterson, N. J. The company is now in a position to assure stock shipment on their line of plating generators, special alternators, controls, panel boards, synchronous motors and plating equipment. The low voltage generator line has been extended to include 2500 ampere machines at 6 volts and synchronous motors at 250 H.P. Charles B. Little, associated with the company for over 30 years, has been elected vice-president.

Leach Relay Co., 5915 Avalon Blvd., Los Angeles, is erecting a 13,000-square-foot addition to its present plant, expected to be completed late in November. The firm manufactures relays, electrically operated switches and similar items.

Glenn L. Martin Co., Middle River, Baltimore, Md., airplanes, have approved plans for a one-story addition, about 400,000 sq. ft. floor space, for parts manufacture and assembling of large bomber planes. Cost over \$2,500,000 of which close to one-half will be expended for equipment. This is the first of several additions planned by the company, to aggregate around 3,000,000 sq. ft. With these new factory additions and with the new machinery now on order, the company will employ upward of 40,000 people. The following departments are operated: drawing, stamping, soft soldering, hard soldering, brazing, welding, plating, sand blasting, grinding, buffing, barrel burnishing, tumbling, descaling, pickling, cleaning, degreasing, lacquering, enameling and painting. The principal base metals used are steel and aluminum.



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Carl C. McLaren, foreman of the plating department, reports the plating room in the new building measures 50 by 100 feet. It has floor troughs, one underground chrome pit for current use, and one pit for future anodizing activity. Other new equipment consists of a second degreaser, a paint and a lacquer spray booth, and two additional sandblast machines; a 12-foot cadmium tank, which is considerably larger than the one in the old plant; and a horizontal "barrel" plating tank. New equipment, other than plating facilities, include two new die-casting making machines, for a total of five. The old plant is to be used as a specialty department and tin shop.

Na-Mac Products Co., 1027 North Seward Ave., Hollywood, Calif., has installed a new plastic machine for making plastic drip cuts in chrome and die castings, and other equipment of a total valuation of approximately \$12,000. Trade demands are tending toward the use of drip cuts of plastic, which prompted the installation of the plastic machine to supplement equipment for producing cuts in other materials.

The firm operates 12 polishing lathes, two chrome tanks for replating gold, silver, copper, brass and nickel. It manufactures air-guns, air-hammers, which are much in demand now in air-plane factories, and other products. W. A. Shuler, member of Los Angeles Chapter, A.E.S., is plating room foreman.

The H. A. Smith Machinery Company, Erie Blvd. East and So. Townsend Street, Syracuse, New York has been appointed a distributor for Sullivan Machinery Company. They will handle the wide and varied Sullivan line of air and gas compressors for industrial uses and will have the assistance of trained engineers to study compressed air problems and recommend suitable installations.

The Carborundum Co., Niagara Falls, N. Y., are building an addition to their plant.

Pennsylvania Mfg. Co., 810 Pennsylvania Ave., Brooklyn, N. Y., metal pocketbook frames and kindred metal specialties, have purchased a six-story building, 100 x 100 ft. at 245 Glenmore Ave., about 60,000 sq. ft. floor space, for a new plant and will remove to new location, increasing capacity. The following departments are operated: rolling, drawing, extruding, stamping, spinning, soft soldering, hard soldering, brazing, welding, cadmium plating, hot galvanizing, hot tinning, vitreous enameling, sand blasting, grinding, polishing, buffing, barrel burnishing, tumbling, descaling, pickling, cleaning (alkaline), degreasing (solvent), rust proofing, lacquering, enameling, japanning and painting. Principal base metals used are steel, copper, brass, bronze, aluminum, and nickel silver.

Public Service Brass Corp., 2901 East Slauson Ave., Vernon, Calif., has under construction three additional units—a 7000-square-foot addition to the foundry, a 3,500-square-foot addition to the machine shop and polishing department, and a 2,300-square-foot addition to the office building.

United States Spring & Bumper Co. has added 24,000 square feet of floor space to its plant at 4951 Magnolia Ave., Los Angeles. Building and new equipment represent an investment of \$75,000, which embraces a new plating room and equipment, additional spur tracks, loading docks and a 40-inch hydraulic press capable of exerting a pressure of 600,000 pounds.

The plating room in the new addition measures 50 by 30 feet. It has been equipped with \$22,000 worth of plating facilities, including three generators costing a total of \$12,000; a 1,500-gallon bright nickel tank; a 750-gallon bright nickel tank; two 450-gallon cleaner tanks; a 200-gallon and a 400-gallon chrome tank, the former a cleaner; a 1,900-gallon copper tank, and three rinsing tanks.

The addition will house the new plating department as well as the bright nickel department formerly quartered in the old building. Plating activity, other than bright nickel, which were already in use, will continue in the old building. The firm manufactures auto springs, bumpers, farm tools, metal guards. Alex Regmont is electroplating foreman and chemist.

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Supply Prices, October 29, 1940

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER:	Cast	22½c. per lb.	NICKEL:	90-92%, 16" and over	.45 per lb.
	Electrolytic, full size, 17½c.; cut to size	17½c. per lb.		95-97%, 16" "	.46 per lb.
	Rolled oval, straight, 17½c.; curved	18½c. per lb.		99%+cast, 16" and over, 47c; rolled, de-	
BRASS:	Cast	19 c. per lb.		polarized, 16" and over, 48c.	
ZINC:	Cast	12½c. per lb.	SILVER:	Rolled silver anodes .999 fine were quoted from 38c. per Troy ounce upward, depending on quantity.	

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, Pure, l.c.l., drums	lb.	.07	Gum, Arabic, white, powder, bbls.	lb.	.125-.14
Acid, Boric (boracic) granular, 99.5%, bbls.	lb.	.053-.059	Sandarac, prime, bags	lb.	.50
Chromic, 99%, 100 lb. and 400 lb. drums	lb.	.16¾-.17¾	Hydrogen Peroxide, 100 volume, carboys	lb.	.20
Hydrochloric (muriatic) Tech., 20°, carboys	lb.	.027	Iron Sulphate (Copperas), bbls.	lb.	.017
Hydrochloric, C.P., 20°, carboys	lb.	.08	Lead, Acetate (Sugar of Lead), bbls.	lb.	.11-.13¾
Hydrofluoric, 30% bbls.	lb.	.07-.08	Oxide (Litharge), bbls.	lb.	.125
Nitric, 36°, carboys	lb.	.06	Magnesium Sulphate (Epsom Salts), tech., bag	lb.	.018
Nitric, 42° carboys	lb.	.075	Mercury Bichloride (Corrosive Sublimate)	lb.	\$1.58
Oleic (Red Oil), distilled, drums	lb.	.07¾-.08¾	Mercuric Oxide, red, powder, drums	lb.	\$3.36
Oxalic, bbls. l.c.l.	lb.	.12-.14	Nickel, Carbonate, dry, bbls.	lb.	.36-.41
Stearic, double pressed, distilled, bags	lb.	.09-.10	Chloride, bbls.	lb.	.18-.22
single pressed, distilled, bags	lb.	.085-.095	Salts, single, 425 lb. bbls.	lb.	.135-.145
triple pressed, distilled, bags	lb.	.11¾-.12¾	Salts, double, 425 lb. bbls.	lb.	.135-.145
Sulphuric, 66°, carboys	lb.	.025	Paraffin	lb.	.05-.06
Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.175	Perchloroethylene, drums	lb.	.08½
Butyl-normal, l.c.l., drums	lb.	.095	Phosphorus, red, cases	lb.	.42
Denat., S.D. #1, 190 pf., 1-18 drms, wks.	gal.	.345	yellow, cases	lb.	.40
Diacetone, pure, drums, l.c.l.	lb.	.10	Potash, Caustic, 88-92%, flake, drums, works	lb.	.07¾-.075
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.36	Potassium, Bichromate, crystals, casks	lb.	.09¼
Propyl-Iso, 99%, l.c.l., drums	gal.	.41	Carbonate (potash) 98-100%, drums	lb.	.06¾
Propyl-Normal, drums	gal.	.70	Cyanide, 94-96%, cases	lb.	scarce
Alum, ammonia, granular, bbls., works	lb.	.035	Pumice, ground, bbls.	lb.	.03
Potash, granular, bbls., works	lb.	.0375	Quartz, powdered	ton	\$30.00
Ammonia, aqua, 26°, drums, carboys	lb.	.02½-.05¼	Quicksilver (Mercury), 76 lb. flasks	flask	\$175.
Ammonium, chloride (sal-ammoniac), white, granu-	lb.	.0521-.075	Rochelle Salts, crystals, bbls.	lb.	.25¾
lar, bbls.	lb.	.035-.05	Rosin, gum, bbls.	lb.	5.25-7.75
Sulphate, tech., bbls.	lb.	.035-.05	*Silver, Chloride, dry, 100 oz. lots	oz.	.32
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	scarce	Cyanide, 100 oz. lots	oz.	.33¾
Sulphocyanide (thiocyanate), com'l, drums	lb.		Nitrate, 100 oz. lots	oz.	.27
Antimony Chloride (butter of antimony), sol.,	lb.	.13	Sodium, Carbonate (soda ash), 58%, bbls.	lb.	.0235
carboys	lb.		Cyanide 96%, 100 lb. drums	lb.	.15
Barium Carbonate, ppted., l.c.l., bags, works	lb.	.03	Hydroxide (caustic soda) 76%, flake	lb.	.0355
Benzene (Benzol), pure, drums, works	gal.	.19	Hyposulphite, crystals, bbls.	lb.	.035-.065
Butyl Lactate, drums	lb.	.235	Metasilicate, granular, bbls.	lb.	.0335
Cadmium Oxide, l.c.l., bbls.	lb.	.85	Nitrate, tech., bbls.	lb.	.029
Calcium Carbonate (Ppted. chalk), U.S.P.	lb.	.05¾-.075	Phosphate, tribasic, tech., bbls.	lb.	.0295
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.05¾-.06	Pyrophosphate, anhydrous, bbls., l.c.l.	lb.	.0580
Carbon Tetrachloride, l.c.l., drums	gal.	.73	Sesquisilicate, drums	lb.	.0425
Chrome, green, commercial, bbls.	lb.	.21	*Stannate, drums	lb.	.34½-.36½
Chromic Sulphate, drums	lb.	.26¾	Sulphate (Glauber's Salts), crystals, bbls., works	lb.	.0135
Cobalt Sulphate, drums	lb.	.65	Sulphocyanide, drums	lb.	.30-.35
*Copper, Acetate (verdigris), bbls.	lb.	.25	Sulphur, Flowers, bbls., works	lb.	.037-.0410
Carbonate, 53/55%, bbls.	lb.	.16-17½	*Tin Chloride, 100 lb. kegs	lb.	.39½
Cyanide, Tech., 100 lb. bbls.	lb.	.34	Toluene (Toluol), pure, drums, works	gal.	.32
Sulphate, Tech., crystals, bbls.	lb.	.05¾	Trichlorethylene, drums	lb.	.08½
Cream of Tartar (potassium bitartrate), gran., bbls.	lb.	.34¾	Tripoli, powdered	lb.	.03
Crocus Martis (iron oxide) red, tech., kegs	lb.	.07	Wax, Bees, white, bleached, slabs 500 lbs.	lb.	.36-.40
Dibutyl Phthalate, l.c.l., drums	lb.	.195	Bees, yellow, crude	lb.	.26-.31
Diethylene Glycol, l.c.l., drums, works	lb.	.155	Carnauba, refined, bags	lb.	.63-.68
Dextrine, yellow, kegs	lb.	.05-.08	Montan, bags	lb.	.27½-.30
Emery Flour (Turkish)	lb.	.07	Spermaceti, blocks	lb.	.24-.27
Ethyl Acetate, 85%, l.c.l., drums, works	lb.	.075	Whiting, Bolted	lb.	.025-.06
Ethylene Glycol, l.c.l., drums, works	lb.	.17-.20	Xylene (Xylol), drums, works	gal.	.31
Flint, powdered	ton	30.00	Zinc, carbonate, bbls.	lb.	.15½-.16½
Fluorspar No. 1 ground, 97-98%	ton	\$60.00	Cyanide, 100 lb. kegs	lb.	.33
Fusel Oil, refined, drums	lb.	.125-.14	Chloride, granular, drums	lb.	.06
*Gold, Chloride	oz.	\$18¼-.23	Sulphate, crystals, bbls.	lb.	.04
Cyanide, potassium 41%	oz.	\$15.45			
Cyanide, sodium 46%	oz.	\$17.10			

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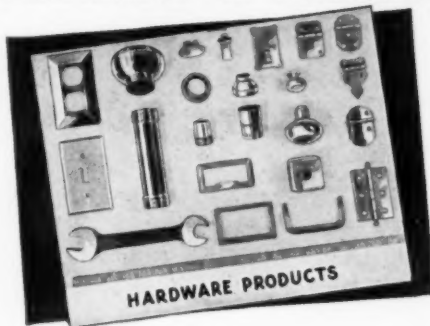
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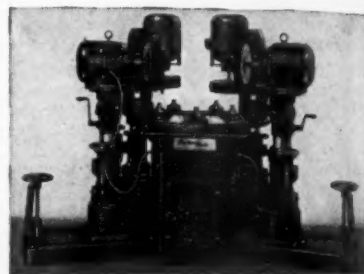
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